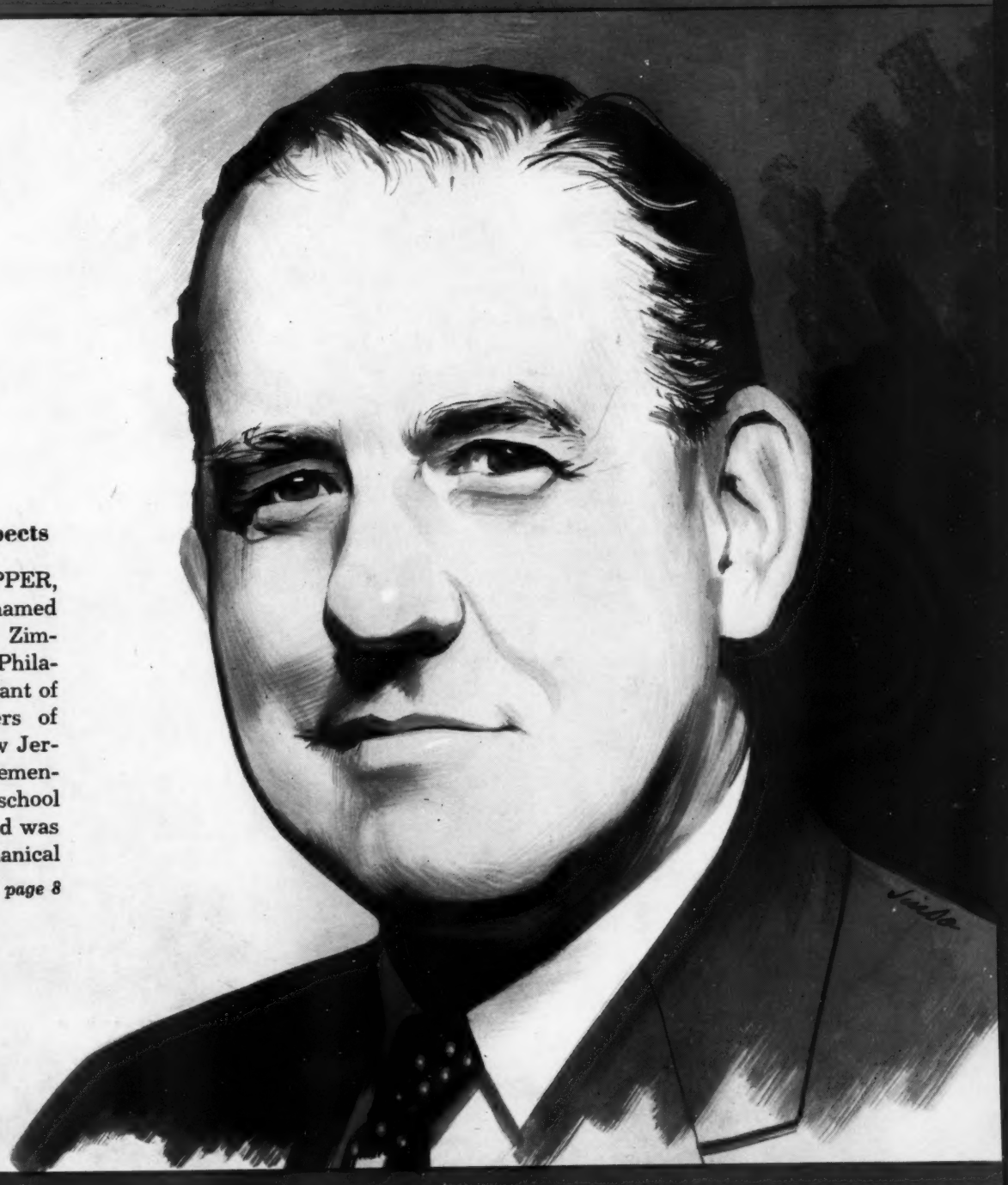
Consulting Engineer

July 1957



The Business Aspects

THOMAS W. HOPPER, who recently was named president of Day & Zimmermann, Inc., of Philadelphia, is a descendant of early Dutch settlers of Bergen County, New Jersey. He attended elementary school and high school in Suffern, N. Y., and was graduated as a mechanical

Continued on page 8

The Consulting Engineer's Professional Magazine

...more

POWELL VALVES

Fig. 2337—Stainless Steel Gate Valve for 200 Pounds W.P. Screwed-in Bonnet. Inside Screw, Non-rising Stem.

Fig. 1847—Small Stainless Steel Swing Check Valve for 200 Pounds W.P.

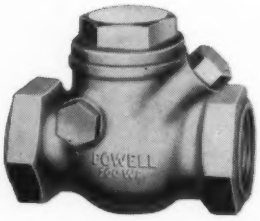
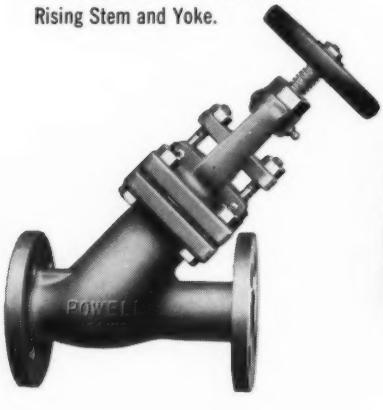
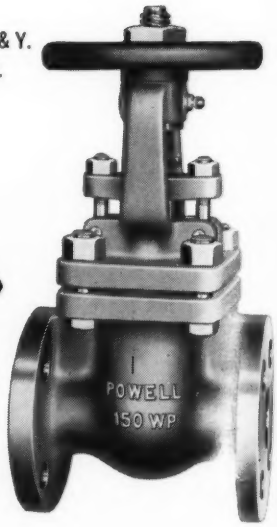


Fig. 2491—Stainless Steel O.S.& Y. Gate Valve for 150 Pounds W.P.

Fig. 2107—Stainless Steel "Y" Valve for 150 Pounds W.P. Outside Screw Rising Stem and Yoke.





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Ask your Powell Valve Distributor for the facts about quality-proved bronze, iron, steel and corrosion-resistant valves. Whatever your flow control problem, there's a Powell Valve to solve it.

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Consulting Engineer®

The Consulting Engineer's Professional Magazine

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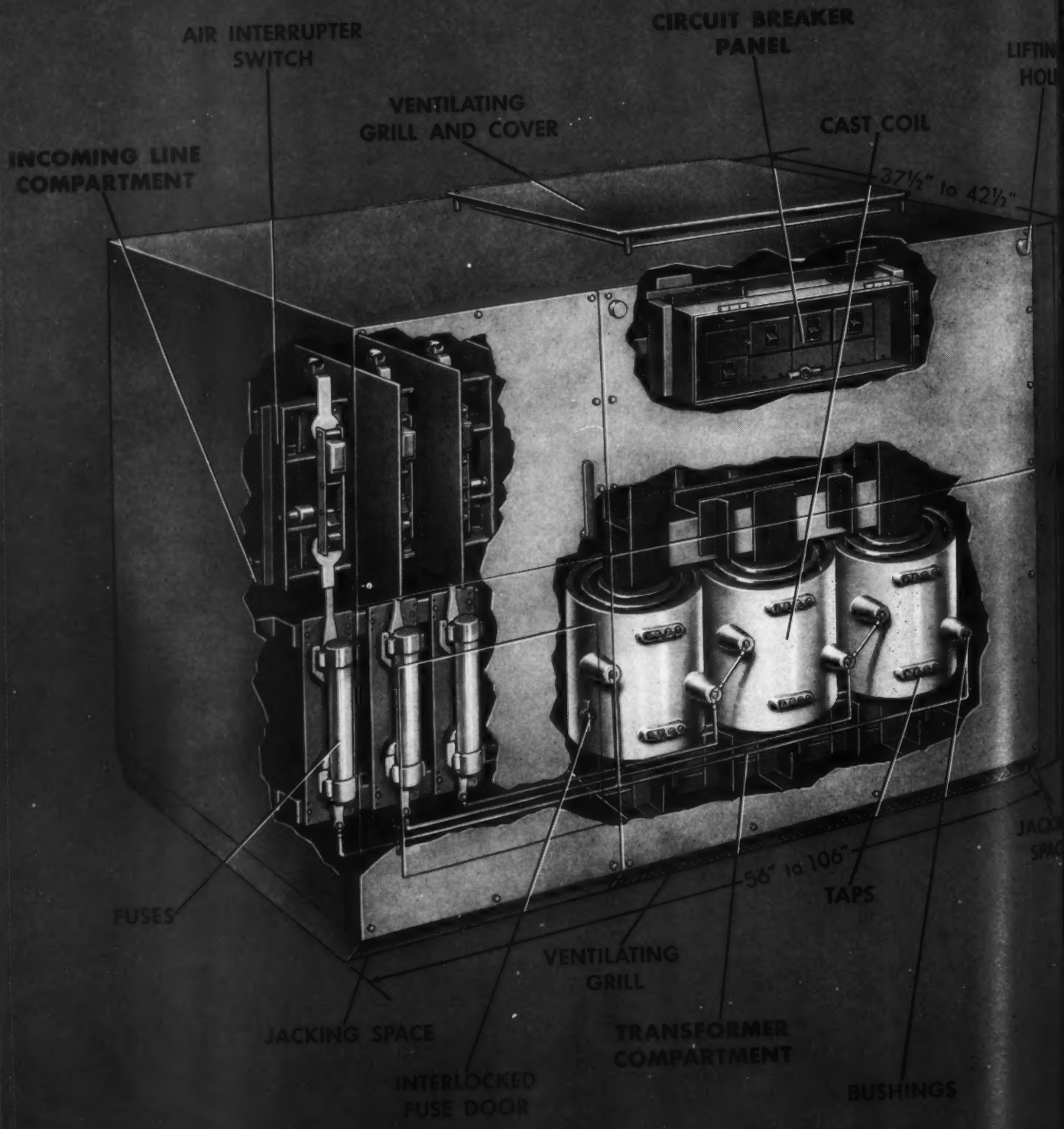
New General Electric cuts installation time,



Typical arrangement of a 15 kv dry-type Integral Distribution Center with fused air interrupter switch

integral distribution center simplifies ordering

Now, General Electric offers an advanced concept in load center design with its new dry-type integral distribution center. This new one-piece G-E distribution center combines the three separate components (incoming line, transformer, outgoing feeder) normally found in conventional systems into the one truly integral unit. Installation time is substantially reduced and ordering greatly simplified.

SMALL enough to pass through any normal size factory door, the new G-E integral distribution center is only 78 inches high (80 inches installed), 37½ to 42½ inches deep, and from 56 to 106 inches wide depending on the accessory equipment required. Unit takes up less space, is easier to handle.

ONE-PIECE DESIGN makes installation easier—eliminates need for assembling and testing separate components at point of installation. Jacking space is built in on two sides of the distribution center—no projecting jacking bosses to get in your way. Once unit is in place, it can be rolled or skidded in any direction for easy positioning. Further, all units are furnished with solderless connectors for incoming and outgoing lines. Both lines can be brought in through either the top or bottom of the unit. Just connect the lines and the unit is ready for operation. Switches, fuses, circuit breakers and taps are front accessible—no aisle space needed on sides of unit. Center is completely metal-clad, inherently fire and explosion resistant—can be placed as close to the wall as local codes will allow.

A COMPLETE LINE is available in standard ratings from 75 to 225 kva for industrial plants, warehouses, office buildings, schools, light-load areas in utility systems and similar applications. Standard voltage ratings run from 208 to 15,000 volts. Units over 5 kv are equipped with encapsulated coils for better resistance to abnormal voltage surges and better protection against dust and moisture for longer life. Bushings and taps are integral parts of each unit meaning less chance of bushing breakage.

QUIET OPERATION is another important feature of the G-E integral distribution center. All one-piece units are rated at 56 decibels—10 decibels under NEMA specification.

AS STANDARD EQUIPMENT on the incoming line section, you have a choice of oil filled cutouts with fuses, air interrupter switches with or without fuses, or terminal connectors. If fuses are used with the air interrupter switch, a mechanical interlock is installed on the fuse door for greater operated safety.

AS EASY TO ORDER AS AN ORDINARY DRY-TYPE TRANSFORMER

Now you can order a General Electric integral distribution center in the same manner in which you would order an ordinary dry-type transformer—*by use, not by the way it's put together.* No need to figure out the size of the switch, fuses or other incoming accessories you might choose. All these things and more are done for you automatically, thus reducing the possibility of inadvertent errors in ordering. Of course, all component equipment meets NEMA and ASA specifications.

To order a G-E one-piece distribution center, just answer these three questions: what is the available primary voltage; what is the desired secondary voltage; and what is the required kva? Then select one of the four standard incoming components. With this information, you or your G-E distributor can determine the General Electric integral distribution center you need from the information given in the G-E Handbook. The only other step necessary to complete the order is to specify the molded case breakers for the secondary breaker panel. Complete information for specifying breakers is also given in the General Electric Handbook.

PRIMARY 480 VOLTS WITH (2) 2½% TAPS ABOVE AND BELOW NORMAL—SECONDARY 208Y/120 VOLTS (WITH TERMINAL COMPARTMENT ONLY)

KVA	BASIC LINE NUMBER	SPECIFICATIONS FOR ALL MODELS			TERMINAL COMPARTMENT		
		Ht.	Depth	Max X	SPECIFIC UNIT NUMBER	WIDTH	WEIGHT
75	9T26Y	78	37½	24	2000	56	1870
112.5	9T26Y	78	37½	36	2002	72	2340
150	9T26Y	78	37½	36	2004	72	2630
225	9T26Y	78	37½	42	2006	80	3210

DETERMINE THE USE, AND THE REST IS AUTOMATIC. The General Electric Handbook contains all the necessary ordering information and prices in chart form—similar to the above, but more complete for other ratings.

FOR MORE INFORMATION, call your nearest General Electric distributor. Or, write to section 410-46, General Electric Company, Schenectady 5, New York for a fact-filled bulletin on General Electric integral distribution centers.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Thomas W. Hopper

—*Starts on front cover*

engineer from Cornell University, in 1929. He had previously spent one year in the College of Arts, at Cornell.

Hopper's family seems to have distinct leanings toward Cornell. Mrs. Hopper has a degree in home economics from Cornell; son Thomas M. Hopper is a mechanical engineer and a Cornell graduate; one daughter, Mrs. John Priedeman, is also a Cornell alumna, and she is married to a civil engineer (Cornell) who is presently serving in the Army and will be employed on management work in Switzerland next year. Another daughter, Helene, is a Cornell freshman.

Prior to joining Day & Zimmermann, Hopper was employed by Stone & Webster Engineering Corporation, in Boston, and Avon Products Corporation, in Suffern. He started to work at Day & Zimmermann in 1942, was named executive vice president in 1956, and was appointed president in February 1957.

Firm History

Day and Zimmermann, Inc., Hopper's firm, had its beginning in Philadelphia, in 1901, as Dodge & Day. The name of the partnership later became Dodge, Day & Zimmermann, and finally, Day & Zimmermann, Inc. One of the founders, Charles Day, an outstanding industrial engineer, was considered a pioneer in the application of scientific methods to industrial operations.

During the 1920's the firm was engaged in the management of utility companies, some of which it owned, and in providing general engineering services to industry and utilities. Design and construction services were provided through Day & Zimmermann Engineering & Construction Company, a wholly owned subsidiary.

In June, 1927, the controlling interest of the company was acquired by United Gas Improvement Company and the utility companies were sold to that firm and others. Day & Zimmermann Engineering & Construction Co. was merged with other construction companies to form United Engineers & Constructors, Inc. The original industrial engineering and reports engineering groups remained with Day & Zimmermann, Inc., which soon became independent again.

Current Operations

The company at present is a service organization performing engineering design and construction, consulting engineering, industrial engineering, appraisals and evaluations, business reports, management of plants and operations, and transit and traffic studies.

Among the present design projects are plants for Corning Glass Works, Radio Corporation of America, Reynolds Metals Co., United Rubber & Chemical Co., Firestone Tire & Rubber Co., and a fifth incinerator for the firm's home city of Philadelphia.

The company also is participating in a joint venture that is making a power survey in Vietnam, and it has been retained by the U.S. Army Ordnance Corps for the management of the Lone Star Ordnance Plant, at Texarkana, Texas.

Civic Responsibilities

Hopper, who heads the firm's 450-man staff, devotes a good portion of his time to governmental and engineering groups. For eight years he has been a member of the Borough Council of Swarthmore, Pa., and he is now Borough president.

"I find that an engineer is particularly well qualified to express opinions on many matters that come before the Council; matters such as sewage disposal, water supply, streets, or street lighting," Hopper said.

"However, before getting too active in community affairs, a young engineer first should establish himself in his profession. Then he should take part in community life — not for what he can get out of it, but for what he can contribute. He always finds that he gains valuable knowledge from the experience."

At Day & Zimmermann, full records are kept of the activities of the 60 staff engineers. First, the young men are urged to become registered. "In my opinion, one cannot be an engineer of standing without being registered," Hopper said.

The records also note whether or not the engineers belong to their Founder Societies and other engineering organizations. "We would not promote a man because of these things alone, but we think participation in society activities shows initiative on the young engineer's part."

As for consulting firms and civic work, Hopper thinks the firms have no obligation to perform engineering for public groups free or below accepted rates. "Like other professional persons, engineers should serve on various local advisory boards without compensation. Also, the firms can make financial contributions to worthy causes. On the other hand, neither the engineer nor his firm should render professional service to governmental bodies without full compensation."

Society Activities

In addition to community activities, Hopper also has worked for many years with the Engineers Joint Council and The American Society of Mechanical Engineers. He served on the E.J.C. Committee on Employment Practices which recently prepared a report on raising professional standards and improving employment conditions for engineers. He is now chairman of that Committee.

Hopper is also a member of the A.S.M.E. Committee on Professional Practice of Consulting Engineering and is vice chairman of the Philadelphia Section of that Society. He is a member and past president of the Cornell Society of Engineers, a member of the Franklin Institute, the Army Ordnance Association,

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For the Sixth* consecutive year... Cooper-Bessemer Power helps win R.E.A. "top-rated" award

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COMPRESSORS: RECIPROCATING AND CENTRIFUGAL
ENGINE OR MOTOR DRIVEN

and the National Society of Professional Engineers.

One of Hopper's chief interests is the role of the young engineer in a consulting firm — what responsibilities the young man has to the firm and how management best can create the ideal situation that will foster his development.

There Must Be Profit

"To begin with, the young engineer should quickly become aware of the fact that engineering as a profession cannot be successfully carried out unless it is provided on a basis that returns a profit to the company. We find a tendency on the part of many engineers to shy away from the business side of their profession. They are content to concentrate on the technical aspects of their work and leave economics, personnel management, planning, sales, and the various administrative problems to others. This is wasteful, and all engineers should learn that engineering, no matter how technical, is a service to business and cannot be separated from it. In my opinion, many engineers who complain about isolation and nonrecognition lack an appreciation and understanding of business fundamentals."

At Day & Zimmermann, Inc. newly graduated engineers are put on drafting and designing work for the first few years of their employment. "I think it basic that an engineer have a thorough knowledge of the techniques involved," Hopper says. He spent three years as a draftsman with Stone & Webster, in Boston, and thinks of that experience as a most valuable part of his background.

Professional Training

Although stress is placed on early drafting training at Day & Zimmermann, there are no large rooms filled with drafting tables where young engineers work at production line drafting. They work in the same areas as the senior engineers and receive professional training through this association.

"At Day & Zimmermann, we are trying to make our engineers a part of our practice. We do not think of them as technical robots under separate management. We want our senior engineers to be concerned about satisfactory client relations, development of new business ideas, and the efficiency of departmental operations. We want them to look on their part of the operation as a separate consulting practice in which they win or lose by their own decisions and performance. We try to instill this philosophy from top to bottom in all departments of our company."

Mr. Hopper also has views on the engineering shortage — "What we need is not more engineers, but more trained technicians to enable us to utilize the engineers we have to better advantage. We must raise the stature of the engineer. We must train and build a force of technicians for him to direct and deal with. The engineer himself must pay more attention to the business side of his work and direct his engineering endeavors and judgment to operations at hand — not merely abstract findings."

The Cost of Living

Hopper pointed out that in Philadelphia an estimated $25,000 a week, or $1,300,000 a year, is spent in newspaper advertising to entice draftsmen and engineers to various firms. He estimates that nationally approximately $25,000,000 a year is spent in an attempt to entice qualified technical personnel that are presently employed.

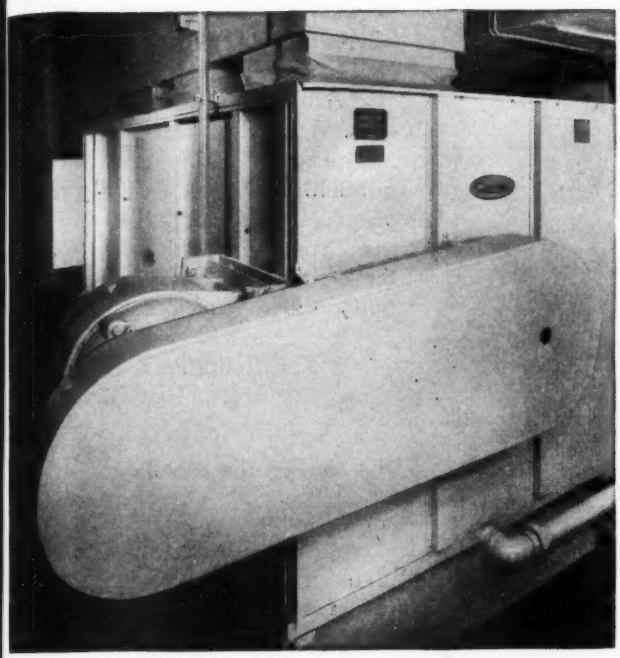
"Such an expenditure can be represented as 5 percent on $500 million of capital tied up in noncreative operations. The same money, if invested in vocational education, would go a long way toward providing excellent technical schools (somewhat more than high school — about equivalent to a junior college course) to provide trained technicians. Then consulting engineers and industry would have a ready supply of well-trained technicians, and many engineers now used on routine work could be assigned to more creative and demanding positions.

Background in Humanities

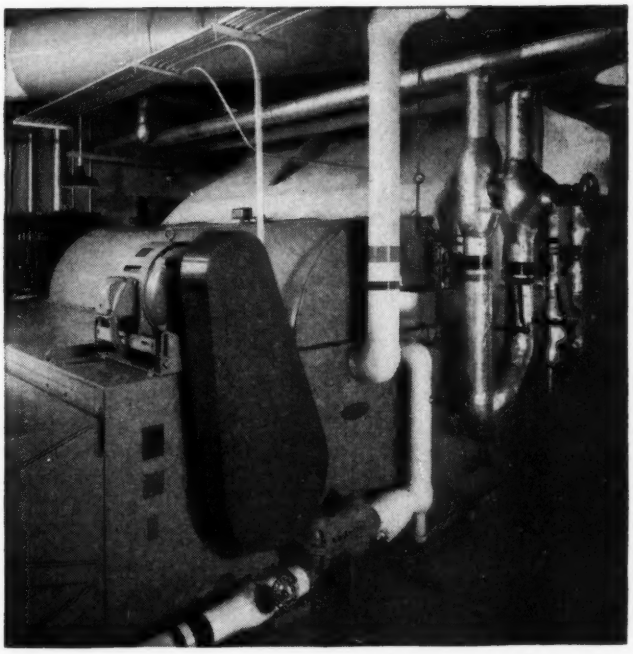
"A good professional engineer must have a good general education, which implies a cultural background acquired through study of language, literature, history, economics, and philosophy. This conditions a man for dealing with people in all walks of life and gives him wisdom in deciding questions affecting men as well as material things."

However, most of the engineer's college training must be devoted to technical and scientific subjects. Hopper sees no way around this if the engineers are to be prepared to practice their profession.

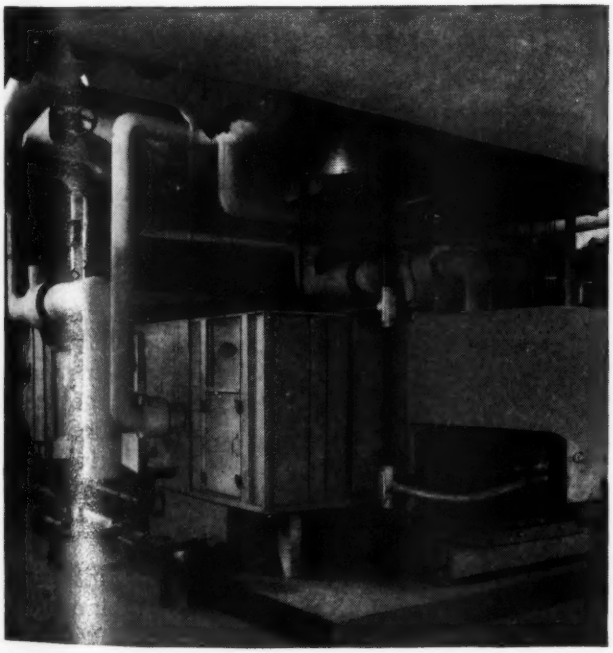
"I think an engineering education must be a rigorous training. This implies a thorough grounding in basic science and mathematics, the acquisition of engineering knowledge, and the development of a technique for solving problems. However, there is nothing to keep an engineer from broadening his own education in the humanities after he has completed his basic training." ▲▲



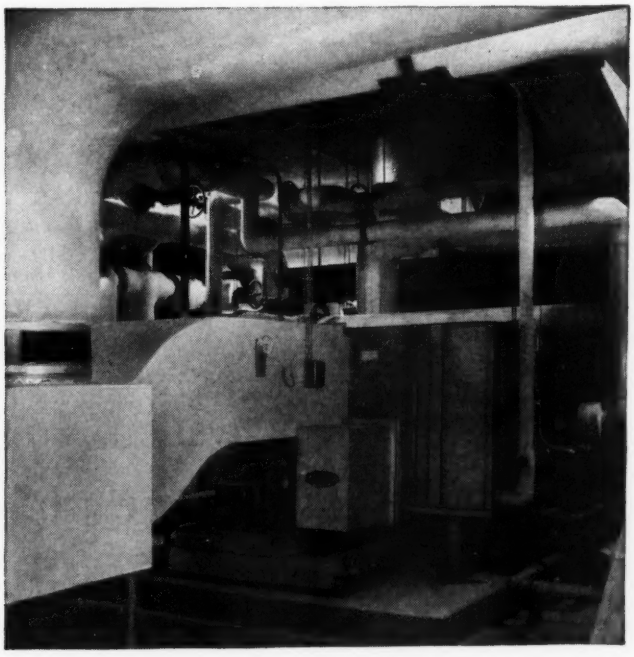
For large open areas, this Carrier Weathermaker* is a good way to condition and distribute air. Using remote sources of refrigeration and heating, it provides cooling, dehumidifying, heating, humidifying, filtering and circulation. Floor or overhead mounting, front or top fan discharge. Nine sizes with a wide choice of coils for direct expansion, chilled water or brine and steam or hot water. Capacities: 1.5 to 100 tons, 400 to 23,000 cfm.



For areas affected by changing loads, this Carrier Zoning Weathermaker is an excellent answer. Multiple mixing dampers connected to hot and cold air plenums permit varying temperature of air supply to each zone. Five sizes, with a wide choice of coils for direct expansion, chilled water or brine and steam or hot water. Uses remote sources of refrigeration and heat. Capacities range from 10 to 80 tons and 2500 to 16,400 cfm.



For multi-story, multi-room type buildings, this Carrier Weathermaker is right for applications employing high-velocity air distribution. Functional components are factory-engineered into a compact assembly complete with insulated fan and coil casing, direct expansion or brine cooling coils, steam coil, recirculating water pump and motor, sprays, eliminators, etc. Capacities range from 30 to 150 tons and from 6500 to 21,000 cfm.



For interior zones, this Carrier Weathermaker is ideal for a system requiring the handling of conditioned air at relatively high duct pressures. Fan and motor have self-contained isolated mounting. Unit has cooling coil, Class III fan, isolated base and a casing enclosure that contains all necessary insulation and accesses. Compact, vibration-free, accessible and serviceable. In three sizes ranging from 30 to 100 tons, 6500 to 23,000 cfm.

*REG. U. S. PAT. OFF.

Readers Comment

Parallel Thoughts

Sir:

The first article that I read [in the May issue] was "The Problems of Private Practice," on page 112. This is one of the best articles I have ever read and it should not only be read, but studied carefully, by every engineer and architect who is in private practice.

It has been my privilege to address many groups of professional men in the design profession on some of the many non-technical problems encountered in professional practice. A half dozen or more formal papers on these subjects, which I have written, have been published. [My paper,] "The Human Side of Specifications Writing," [was] presented at the Joint Producers Council Construction Specifications Institute — A.I.A. meeting in Washington, D.C., on Monday, May 13th. Almost every point covered in the paper is not only mentioned in the "Private Practice" article but the conclusions expressed therein are surprisingly parallel to those expressed by the undersigned.

You are to be congratulated on publishing the very timely article on private practice. It is my hope that you will continue to offer these problems sorely needed publicity and discussion.

Kenneth M. Wilson
E. F. Klingler & Assoc., Inc.
Eau Claire, Wis.

The Backgarden of Allah

Sir:

Any consulting engineer who plans to undertake a project in the Middle or Near East had better pause to meditate about some of the frustrations with which he must contend.

The Arabs have their own concept of time, money, and life in general. Whatever Allah decrees shall be, and the Arab sees no point in worrying about such worldly things as contracts, construction deadlines, or money.

There is always tomorrow. The Arab is motivated by no desire to accumulate worldly comforts, but merely breathes his allotted span of years.

Why worry? Everything is in the hands of Allah.

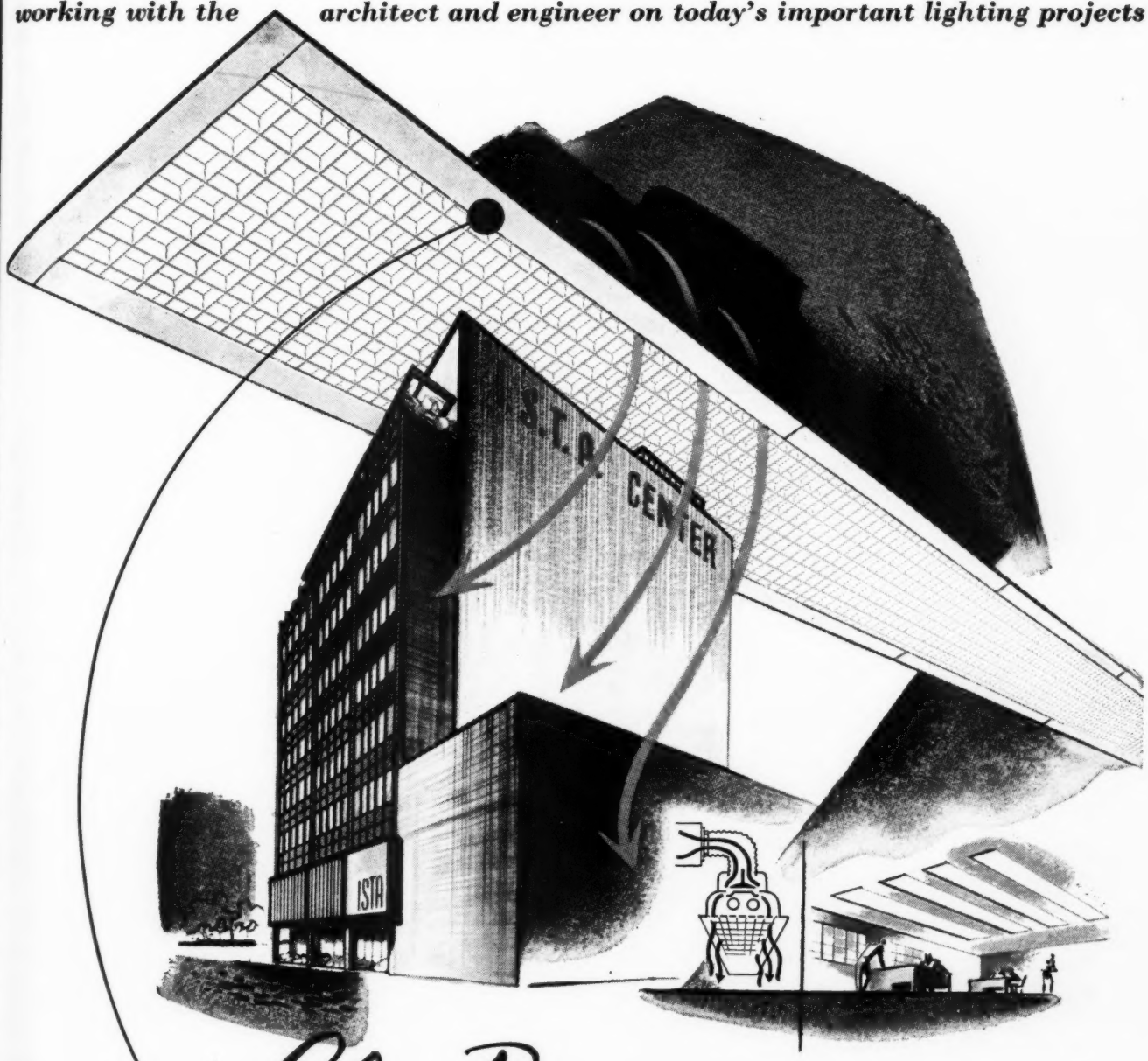
If a hammer meets a sheet of glass and the glass shatters, do not blame the Arab who wielded the hammer. It was the will of Allah and could not be avoided.

To see an Arab speeding along a highway, with his safety in the hands of Allah, is an experience. If the truck fails to negotiate a curve at 80 miles an hour, do not blame the innocent driver. He saw the curve, but he thought he could make it. Allah decided otherwise.

The sight of a contract brings out the inherent Arabian dread of making decisions. The Arab must have time to think, time to pray, and time to do nothing. Your deadline is of no concern to him. It is of your own making, and contrary to the Will.

You, of course, will have an Arabian contact man. However, do not think that because he was educated in Boston or Cleveland his basic attitude is American. He

working with the *architect and engineer on today's important lighting projects*



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both lighting and air conditioning from one fixture!

These new double-duty fixtures bring a new freedom to creative architecture. Gone is that discord of fixtures and air outlets! Instead: clean-lined, uncluttered ceiling beauty. Air outlets are engineered right into the lighting system! Result: greater economy, comfort and ceiling beauty. No double installation problems . . . improved draft-free air diffusion . . . modern, well-diffused, high efficiency Benjamin troffer lighting. Free illustrated brochure brings you the whole fascinating story of this new 2-in-1 fixture. Write: Benjamin Electric Mfg. Co., Dept. CEN, Des Plaines, Ill.

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BENJAMIN
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realizes your anxieties and insecurity, but he feels superior to such emotions.

Before a contract is signed, you will be invited with your contact man for tea. After drinking tea and coffee, and eating bananas and sweet lemons, you will find there was no occasion to discuss business. Maybe tomorrow.

The contract will present other difficulties. Arabic cannot be translated literally into English. A legal representative should be retained, and any misunderstood phrases should be agreed upon before witnesses.

Remember, any lawsuits must pass the religious as well as the civil courts and this could take 10 years. Some persons have been jailed pending trial.

The consulting engineer, as the foreigner, will find he has many other pertinent customs to learn.

For instance, a hat is associated vaguely in the Arabian mind with some unknown religious caste, and is regarded with disfavor. The "Town Arab" has adopted the hat, and is disliked and held in suspicion by the Bedouin. "Town Arabs" and the Bedouin from outlying areas should not be mixed on a construction job, or trouble will result.

The Arab's religion demands total fasting during the month of Ramadam, so cancel any hope of much work from the construction gangs during this period. Other religious observances also will delay progress.

Other surprises which Allah may decree for you include a contractor's sudden demand for a 100 percent pay increase, or he quits. Or a 300 percent price-of-living increase in the construction area during about a six-months period.

One thing is certain.

These little inconveniences were the Will of Allah.

Anthony A. McLoughlin
Survey Consultant
Manchester, England

Sewage Lagoons

Sir:

We have been informed that an article appeared in the December 1956 issue of CONSULTING ENGINEER that concerned the use of sewage lagoons or oxidation ponds and are most interested in obtaining either a copy of this issue of your magazine or tear sheets of this article.

George L. Hall, Chief
Div. of Sanitary Engineering
State of Maryland
Department of Health

• THE ARTICLE WAS "SEWAGE LAGOONS ARE THE ANSWER." WE HAVE REPRINTS THAT ARE AVAILABLE FREE OF CHARGE.

From Cover to Cover

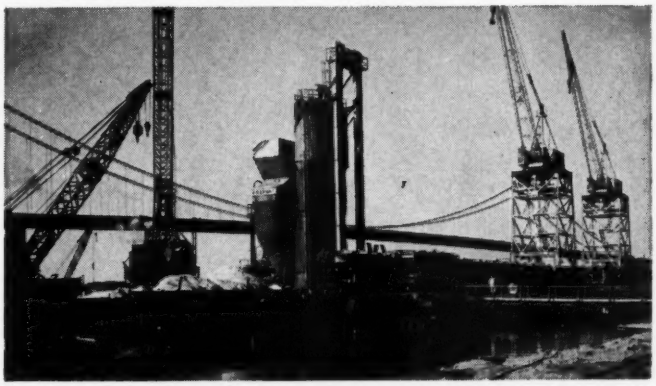
Sir:

. . . I believe that I have complimented you previously on the magazine, but wish to re-emphasize my opinion that the articles are well presented and diverse in character. In fact, the presentation is such that the magazine stays on

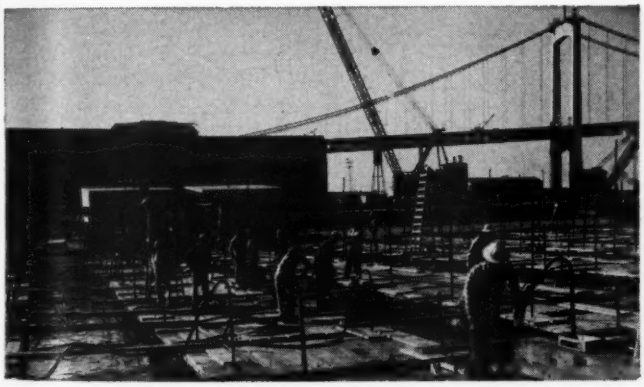
How world's largest underwater concrete placement was made at Camden drydock

Building one of the world's largest drydocks at the New York Shipbuilding Corp., Camden, New Jersey, required the underwater placement of a 134,200-cu. yd. Prepakt concrete floor slab. Here's how this unprecedented placement was made:

First move was direct placement of coarse aggregate from bottom-dump barges inside cellular sheetpile cofferdam. Barges arrived via Delaware River (rear).



Next, Intrusion grout was batched, mixed, pumped from Prepakt plant. I-P methods made possible economical construction of a gravity floor slab, avoiding costly hydrostatic relief of structure.



Underwater consolidation of aggregate was done from rafts. Live grout face was maintained throughout continuous six-week grouting operation.

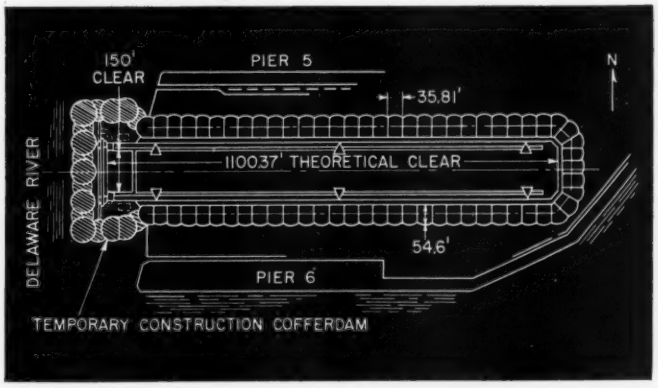


Diagram shows dimensions and location of drydock. Unreinforced Prepakt concrete slab is 17 to 25 feet thick.

Contractor: Merritt-Chapman & Scott Corp.

Consulting Engineers: Parsons, Brinckerhoff, Hall & Macdonald

With grouting completed, slab was cured for 30 days. Dewatering later revealed a monolithic slab—a firm base for new Forrestal-class carriers.

Intrusion-Prepakt, Inc., Room 568, Union Commerce Bldg., Cleveland 14, Ohio. In Canada: Intrusion-Prepakt, Ltd., 159 Bay Street, Toronto, Ontario.

INTRUSION-PREPAKT, INC.

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Intrusion and Prepakt are trade marks of Intrusion-Prepakt, Inc., whose methods and materials are covered by U. S. Patents Nos. 2313110, 2655004, 2434302 and others, also patents pending.

my desk until I have had time to read it thoroughly . . .

W. R. Kahl, Pres.
Consulting Engineers Council
of Maryland
Baltimore, Md.

More on W.H. Trade Corporations

Sir:

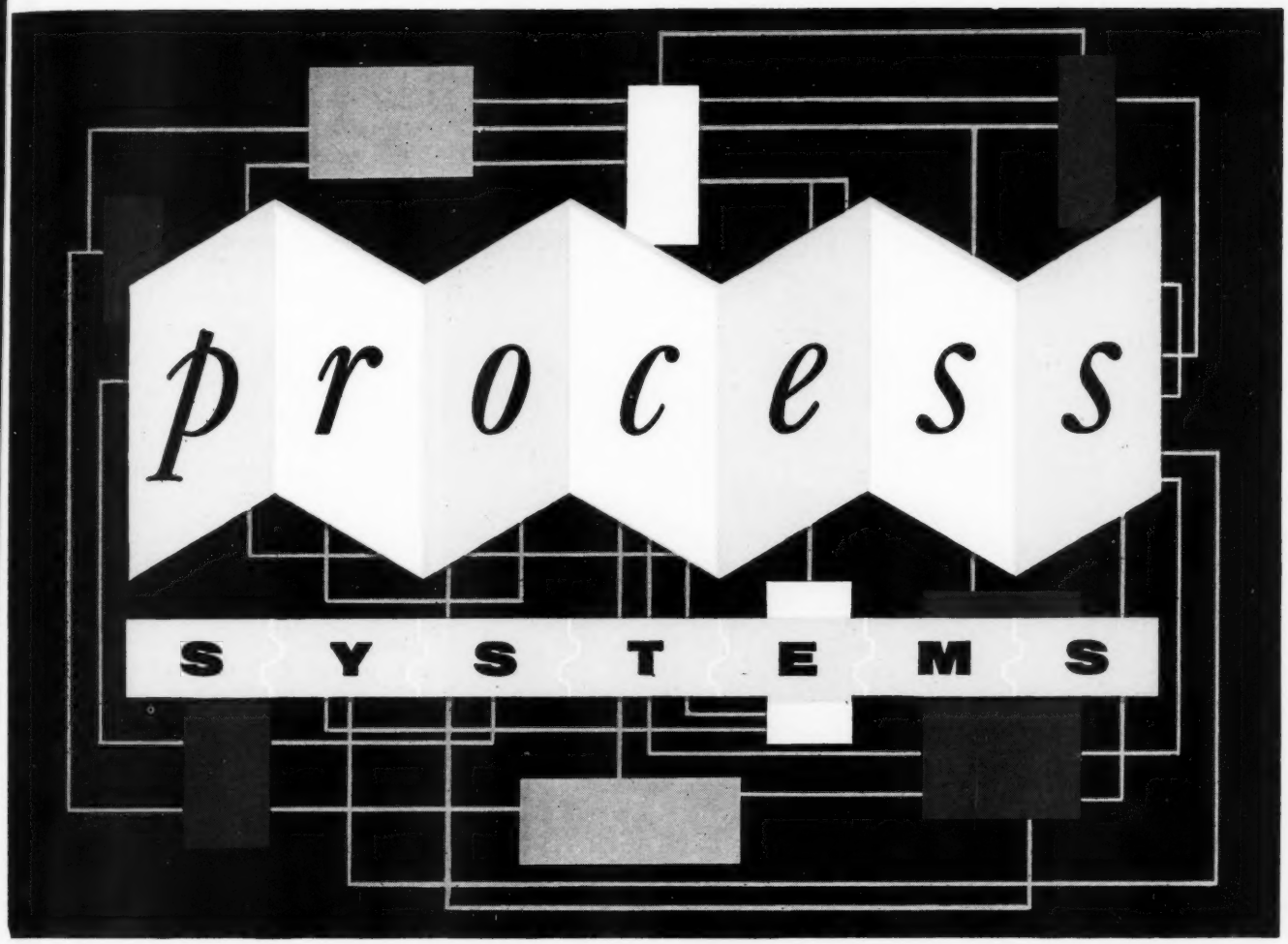
It should first be noted that the special deduction for Western Hemisphere Trade Corporations (See "Increase Your Income with a Western Hemisphere Trade Corporation," June CE) is allowed only against the corporate tax—not for individuals. Accordingly, the earnings of the corporation will still be subject to an additional tax if and when they are distributed to the individual stockholders. If distributed as dividends they will, of course, be taxed at ordinary income tax rates. If all earnings are taxed to the shareholders as dividends eventually, it is likely that there will be a tax disadvantage for an engineer in forming a Western Hemisphere Corporation.

The way to avoid this undesirable result is to leave the earnings in the corporation and eventually liquidate it so that the earnings will be received as a capital distribution taxable at capital gain rates (one-half of the income taxed, with a maximum rate of 25 percent on the entire income).

The difficulty with retention of earnings for this purpose is that retained earnings in excess of $60,000 may be subject to an additional 27½ percent accumulated earnings tax under section 531 of the Code unless retention can be ascribed to some business purpose as distinguished from retention merely to save the stockholders payment of taxes.

Of course, if the engineers are already operating through the corporate form, and the Western Hemisphere corporation is merely a subsidiary, then a substantial savings in the difference in corporate tax rates will be realized as shown in the government's table of tax computation.

If one is successful in using the capital gains method, the net tax paid on $100 of foreign income, once the money is in the engi-



PUT SYSTEMS THEORY INTO PRACTICE

It's one thing to define systems theory, quite another to put the principles into practice. Automatic end point process control can only be achieved by coupling systems theory with *sound instrument engineering.*

At Fischer & Porter, system designers define control relationships . . . probe the process dynamics. When classic mathematical techniques prove inadequate, general purpose analog computers simulate control relationships under all conceivable conditions . . . at a mere fraction of the cost required with actual instruments.

Thus, the foundation is laid for an optimum system. But building it is the job for F&P instrument engineers. Ranges . . . accuracies . . . speeds take the place of parameters. Indicating, recording, and control instruments . . . data loggers . . . computers—fill the system diagram block by block. Critical instruments are individually tested in special purpose laboratories . . . even locked into the system analog if necessary.

This combination of systems analysis and instrument engineering led Fischer & Porter . . . to develop automatic loggers, multiple pressure readout systems, and analog-to-digital converters . . . to integrate a computer into a process control system for *instantaneous optimizing* of the entire system, for the first time in control history.

This is the philosophy by which Fischer & Porter systems are built . . . imaginative systems design supported by realistic instrumentation. Put the F & P systems approach to work on your clients' processes by getting in touch with the F & P sales engineer nearest you. Or, write Fischer & Porter Co., 4977 County Line Road, Hatboro, Pa. In Canada, write Fischer & Porter (Canada) Ltd., 2700 Jane St., Toronto, Ontario.

FP

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Complete Process Instrumentation

DRAFTING TRENDS

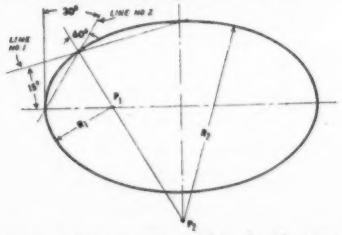
This free booklet, newly developed by the Frederick Post Company through the co-operation of leading engineers and draftsmen, shows 59 shortcuts to speed drafting and computation work.

Ideas for increasing drafting and engineering efficiency

POST went to leading engineers and draftsmen and asked them what techniques they use to save time without sacrificing precision in their work. From the many interesting tips and drafting shortcuts suggested, a total of 59 have been compiled into one handy booklet called "Time Saving Tips for the Draftsman and Engineer."

Clearly written and well illustrated, this booklet shows new approaches to old problems. The section on CALCULATING IDEAS contains 10 tips including easy ways of "Remembering the Signs of Trig Functions," "Dividing a Circle Into Parts," and "Locating Decimal Points."

One of 22 Drafting Shortcuts



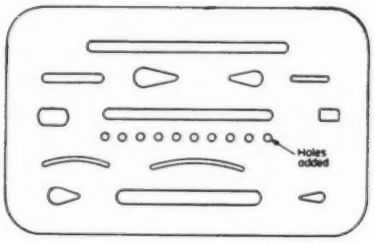
Here is what seems to be the fastest and easiest method of constructing an approximate ellipse: (1) Draw a line at 15° to major axis as shown. (2) Draw a line at 30° to minor axis as shown. (3) Draw a line at 60° to line #2 through intersection of lines #1 and #2. (4) Draw Arc R_1 from point P_1. (5) Draw Arc R_2 from point P_2.

9 tips in Engineering Data Section

Easy-to-use, practical shortcuts to formulas and other engineering data are featured in this section. Two of these time savers are faster methods of "Determining Gear Inertia" and "Interpolating Between Family of Curves."

One of 18 Board Timesavers

Fairly often when drafting it becomes necessary to change a solid line to a dotted line. By placing a series of holes in an erasing shield, as shown, it is possible to make the conversion simply by erasing through the holes.



For your free copy of "Time Saving Tips for the Draftsman and Engineer," contact your POST *dealer or write today to the Reader Service Division of Frederick Post Company, 3656 N. Avondale Avenue, Chicago 18.*

POST

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ENGINEERING EQUIPMENT & DRAFTING SUPPLIES • FIELD EQUIPMENT & DRAFTING FURNITURE

neer's pocket, will run from approximately $41 to approximately $63. This computation is based on the effective Western Hemisphere tax rate on income under $25,000 being 21.9 percent, and over $25,000 being 37.96 percent, plus the 25 percent capital gains tax.

Thus, generally speaking, the use of the Western Hemisphere corporation is more beneficial when utilized by a domestic corporation as a subsidiary. This is because the earnings are already subject to the "double" corporate tax and a lower effective rate is achieved by the Western Hemisphere trade classification.

Another difficulty in the use of a Western Hemisphere corporation by an engineering partnership is the possibility of being held a personal holding company. These are subject to a whopping 75 percent penalty tax. The Western Hemisphere Trade Corporation would be held to be a personal holding company if under the contract to furnish services, the customer had the right to designate the individual who is to perform the services or if the individual who is to perform the services is designated in the contract . . .

L. Wm. Seidman, C.P.A.
Seidman & Seidman,
Certified Public Accountants
Grand Rapids, Mich.

Important Contributions

Sir:

. . . Your excellent magazine is continuing to increase in stature, and is making many important contributions toward the advancement of consulting engineering. We also find the selected advertising very helpful in keeping us posted on product developments.

Roy J. Thompson, P.E.
Carnahan and Thompson
Oklahoma City, Okla.

Thoughts at Random

Sir:

I have been quite concerned about the splitting of the engineers' influence at the national level. Even at the state level the Texas Society of Professional Engineers had a recent legislative

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Aerofin is sold only by manufacturers of nationally advertised fan system apparatus. List on request.

There is a competent Aerofin heat-transfer engineer near you, qualified by intensive training and long experience to find the *right* answer to your own particular heat-exchange problem.

This specialized knowledge is there, ready for you to use to your greatest advantage. Ask the Aerofin man — and be right.

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101 Greenway Ave., Syracuse 3, N. Y.

defeat handed them reputedly in large measure because they were not united as (and within) a society. Undoubtedly had there been two or more groups involved, the cleavage would have been even greater.

Your material covers the technical, professional, and business fields—and good. As a practitioner in a limited field I find the articles such as that on "Designing Thin Shell Structures" of considerable help in comprehending what is going on in the rest of the engineering world. To help me: it would be helpful if a glossary of even the simplest terms were furnished to give me some idea as to the meaning of words which must be most common to those who practice in the field, e.g., "folded plates," which I must admit are described as "simple straight form segments" in the article — but even this is over my head. Possibly I should stick to my own knittin'.

William G. Darley, E.E.
Consulting Engineer
San Antonio, Texas

Too Much Excellence

Sir:

You keep sending me your excellent magazine — and it is indeed excellent — although I have not subscribed for it. I take too many excellent engineering magazines now; it would take my entire time to read all the articles of particular interest to me. Besides I am 75 years old and not as spry as I used to be. So please do not assume that I am going to pay for your subscription.

J. G. Moore
Daytona Beach, Fla.

ambient compensated breakers . . .

Westinghouse

Whenever circuit breakers are subject to wide ambient temperature variations to which associated conductors are not exposed, an ambient compensated type of breaker should be specified. This provides added insurance against current interruptions due to false high-temperature influences. The net effect is to prevent the breaker from unnecessarily derating the conductors.

Typical of the conditions under which ambient compensation may be required are . . .

In panelboards or load centers where a large number of closely grouped breakers create high temperatures.

Proximity of breaker installation to other equipment causing ambient variations to which the conductors are not exposed.

Westinghouse has the only complete line of circuit breakers to meet every requirement. (1) "Compensated for enclosure ambient," standard in Quicklag® breakers, (2) "Noncompensated for ambient re-rating," standard in Types E through M, (3) "Ambient compensated," by specification in Types E through M.

The engineering "know-how" which goes into the development of this reliable protective equipment is available to aid you in selection of the right type of breaker for your particular circuit conditions. Ask for Westinghouse Bulletin 7221 detailing technical information on the choice of circuit breakers.

J-30277

Get proper breaker protection under all ambient conditions.

YOU CAN BE SURE... IF IT'S

Westinghouse

Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pennsylvania

Scraps & Shavings

A FIRM OF CONSULTING ENGINEERS, like a living thing, must either grow or die. It is impossible for it to stay the same size and handle the same volume of business year after year. The firm must be willing to expand, to take on more work and new kinds of work every year, or go into a gradual decline ending in failure.

This characteristic of a business is well known to most business men, but engineers are inclined to overlook or ignore it. Perhaps the engineer, knowing that he is a professional man, thinks he can operate in the same manner as the doctor or lawyer in private practice. A doctor can maintain about the same volume of work year after year throughout his working life. But when he retires or dies, that is the end — his office closes, and his patients must go to other doctors.

This type of operation is possible in engineering only in the one-man office. Larger organizations look forward to the continuation of the firm beyond the retirement or death of any one partner or principal. In this respect, a firm of consulting engineers is similar to a business. The engineer, himself, is a professional man, but the firm is a business operation, and as such, it must grow or die.

This is an era of unusual economic prosperity. Most consultants can expand their organizations. It may be hard to find good employees, but it is not hard to find clients. This is the time to grow. The engineer who tries to stand still now will soon find that he has not stood still but has slipped backward. Other engineers will be far in front of him in experience and client backlog. He not only will be on his way down but on his way out.

Now is the time to add another partner or principal. Now is the time to expand the staff, to take on new clients and larger and more difficult projects.

Government agencies are being forced to use consulting engineers whether they want to or not. The highway program and all other major public works are under way. The various local, state, and federal agencies cannot hope to handle all the design work with their own staffs. They must have consulting help. If they get that help, they will learn that it saves them time and money to work with consultants; there will be plenty of work for consultants even when the peak programs are over. But if consultants turn down jobs, refuse to expand, the government agencies will be forced to manage somehow on their own. If this happens, there will not be much work for the consultant when the rush is over.

The same is true in industry. Engineers are so busy with routine production that they need consulting engineers to whom they can turn over all special jobs. There are industries looking for consulting engineers to handle certain aspects of product design and plant operation. There are even industries who want engineers in private practice to take over supervision of plant maintenance.

There also are foreign projects begging for good engineering. Not only are the talents of American engineers needed in the industrially backward countries, but even the nations of Western Europe need the special skills and abilities of American engineers. It is true that some of the most brilliant engineering minds are in Western Europe, but American methods and techniques have been used to save both time and money on European projects, and European industrialists know it.

The work is waiting to be done. If consulting engineers do not do it, it will be done by others, and this opportunity will be missed. Most engineers in private practice would prefer to stay small, would like to participate personally in every aspect of every project. Engineering talent, however, is not the exclusive property of one man. It can be hired. New partners can be brought in. Good men can be promoted. The firm can grow.

There are some consulting engineers who look ahead and see the day when 90 percent of the graduate engineers in this country will no longer be working for industry and government. Instead, they see this reversed; they see engineers in private practice and their engineer employees in the great majority.

That is the direction in which we are moving. But we can achieve that goal only by the continual growth of each firm. It is up to consulting engineers to meet the current demands for their services. Each firm must grow or die. ▲▲

ONE PACKAGE "Pre-engineered" AIR CONDITIONING SYSTEM

THE DUNHAM-BUSH 'CPU' COMMERCIAL PACKAGE UNIT

This pre-engineered Dunham-Bush unit is a complete air conditioning ***system*** housed in one cabinet. Each unit is ***entirely self-contained*** . . . with evaporator, compressor, evaporative condenser and pump, fans, motors, piping and controls . . . all ***pre-engineered*** to provide peak operating performance at minimum operating cost. Installation requires only connection of power supply to control panel, connection of water make-up line and necessary duct connections. All units are run in and tested before shipment and are shipped with a holding charge of Freon.

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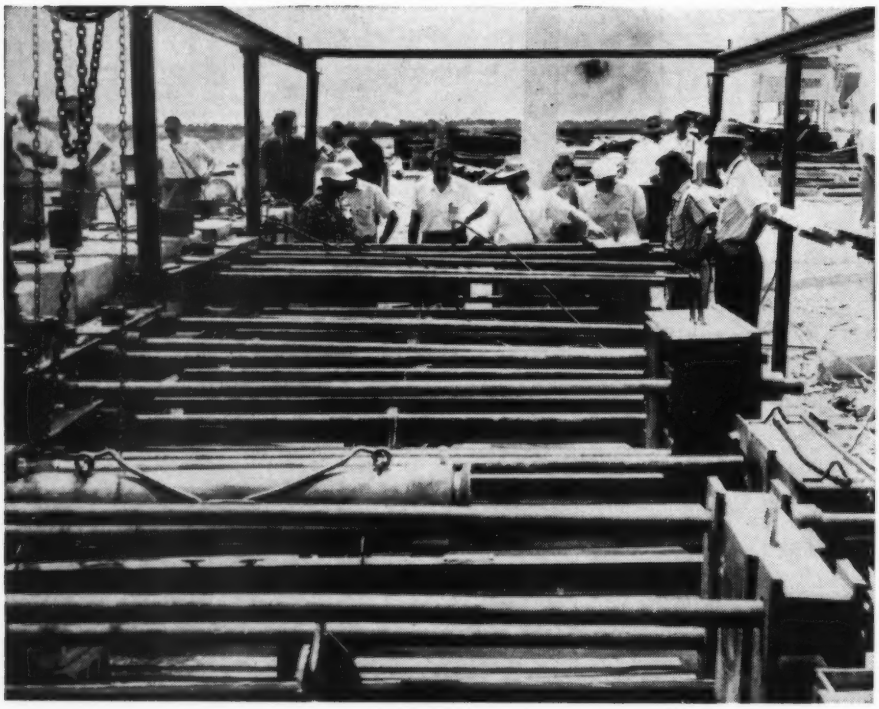
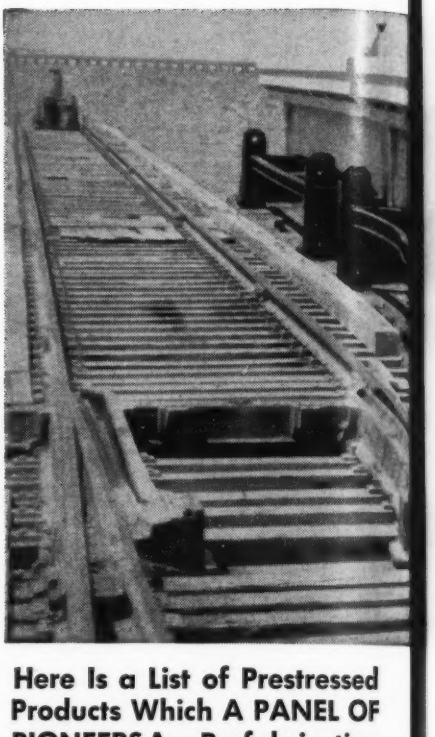
This Amazing Prestressed Concrete Industry





What Is Behind Its Phenomenal Growth?

This is a question which has been asked many times. Union Wire Rope Corporation has answered with the sound reasons for venturing a huge capital investment in expanded facilities and in research to master the technical know-how of producing prestressed, stress relieved, high tensile wire and strand. Without this key element prestressed concrete would still not be possible and practical.

To check our own reasons and to develop all of the fundamental facts responsible for the spreading use and acceptance of prestressed concrete,

We Asked A PANEL OF PIONEERS In the Prefabrication of Prestressed Concrete Members To Summarize the Facts Which Has Enabled Them To Maintain a Yearly Growth of 200 to 300 Percent.

What follows is straight from the horse's mouth. It is a summary of the fundamental facts contributed by a sizeable group of prestressed fabricators and consultants. All are pioneers who have had a part in the development of prestressed concrete and experienced its growth from a trickle five years ago to become the building material to be reckoned with by every factor in the building industry.

Here Is a List of Prestressed Products Which A PANEL OF PIONEERS Are Prefabricating

Girders

Roof Slabs
Regular, Lightweight, Lift, Channel, Thin shell, Hollow centers, Composite.

Beams
Joists
Trusses
Columns

Piles and Caps
Foundation, Marine, Fender

Lintels
Wall Panels
Siding
Posts

Pavements
Highway, Airport

Stadium
Framing, Seats

"Future Applications of Prestressed Concrete Beyond Prediction"

These are the words of one and the consensus of opinion of others on our panel of pioneers. Other prestressed concrete products mentioned as either being prefabricated or tested and proposed are:

- Missile Wings
- Barges
- Transmission Line Supports
- Piers
- Seawalls
- Wharfs
- Arches
- Skews
- Spring Board—For Swimming Pools
- Off-shore Drilling Piles Platforms

While some of these may seem novel, many will become commonplace. Prestressing concrete for barges, for example, could very well become an industry in itself as is the prefabricating of bridge members.

The Word *from* Washington

EDGAR A. POE
Consulting Engineer Correspondent

BOTH the Senate and House Public Works Committees have before them bills that would authorize the Tennessee Valley Authority to issue self-supporting (not government backed) revenue bonds to keep up with the growing power load in the area. Hearings have been held before both committees. Additional hearings are proposed in the House.

THE National Society of Professional Engineers has filed opposition to an identical section in Senate and House companion measures that would empower TVA to offer engineering and design services to any outside interest having some type of relationship with TVA. This would mean that private consulting engineers would be cut off from many clients and potential clients.

Despite the opposition, there is no immediate indication thus far that either the Senate or House Committee plans to strike out or amend the provision. Representative Robert E. Jones, Jr., Democrat of Alabama, co-author with Clifford Davis, Democrat of Tennessee, of the House bills, maintained that the provision would not hurt private consulting engineers. He said that the expanding economy within the TVA region is "going to bring more and more need for consulting engineering and design services. They will have nothing to fear by such a provision."

The fate of the bills is up in the air. Congressional approval, at least during the remainder of the year 1957, appears doubtful. Because this is the first session of the 85th, the proposals could go over into the 1958 session without dying.

THE Bureau of Public Roads evoked sharp criticism earlier in the year when it recommended insertion of a clause in state highway contracts forbidding consulting engineers to engage technical people who had been employed by the BPR or a state, county, or municipal highway department. As a result of the criticism of the second document which consulting engineers did not like, the BPR began work in April on a third memorandum which they hope that engineers generally will approve. The BPR consulted all its field offices before preparing the third directive—not yet issued.

CONGRESS is not ready to expand the 41,000-mile interstate highway system despite a recommendation of a Senate Public Works Subcommittee. Neither does the Eisenhower administration favor the proposed 7000-mile increase until the program is further along.

OFFICIAL Washington is revising estimates of productions, and of goods and services. Business is going to be better than 1956, the economists are now saying. Increased spending for practically all types of public work has been a paramount factor in keeping dollar volume in 1957 ahead of 1956.

A Special House Post Office and Civil Service Committee reports that it has strong evidence that tax money has been used in subsidizing and pirating of engineers for firms having government defense contracts. As a result the report said that pirating has created an inflated demand and is unfair to those without defense contracts. Chairman James C. Davis, Democrat of Georgia, said testimony to his committee on recruiting costs for defense contract engineers showed the "startling difference in recruiting costs for the firms with defense contracts and those without." He said firms with defense contracts spent more than 10 times as much for recruiting as those without contracts.

Meantime, the Army, Navy, and Air Force have auditors checking government defense contracts in an effort to determine if there is hording of engineers. At the same time the Defense Department is seeking ways to make better use of engineers. These include establishing standards and making continued reviews of the use of civilian and military engineers within the government.

The Davis committee predicted that 95 percent of the complaints of government use of engineering talent will be eliminated if the Defense Department stamps out its misuse of civilian and military talent. In a message directed to the various agencies of the government, Chairman Davis declared pointedly that "this nation cannot afford the luxuries of unnecessary defense expenditures and extravagant use of engineering talent. Our Defense contracts must not be managed like glorified WPA projects." ▲▲

Argonne National Laboratory Experimental Boiling W

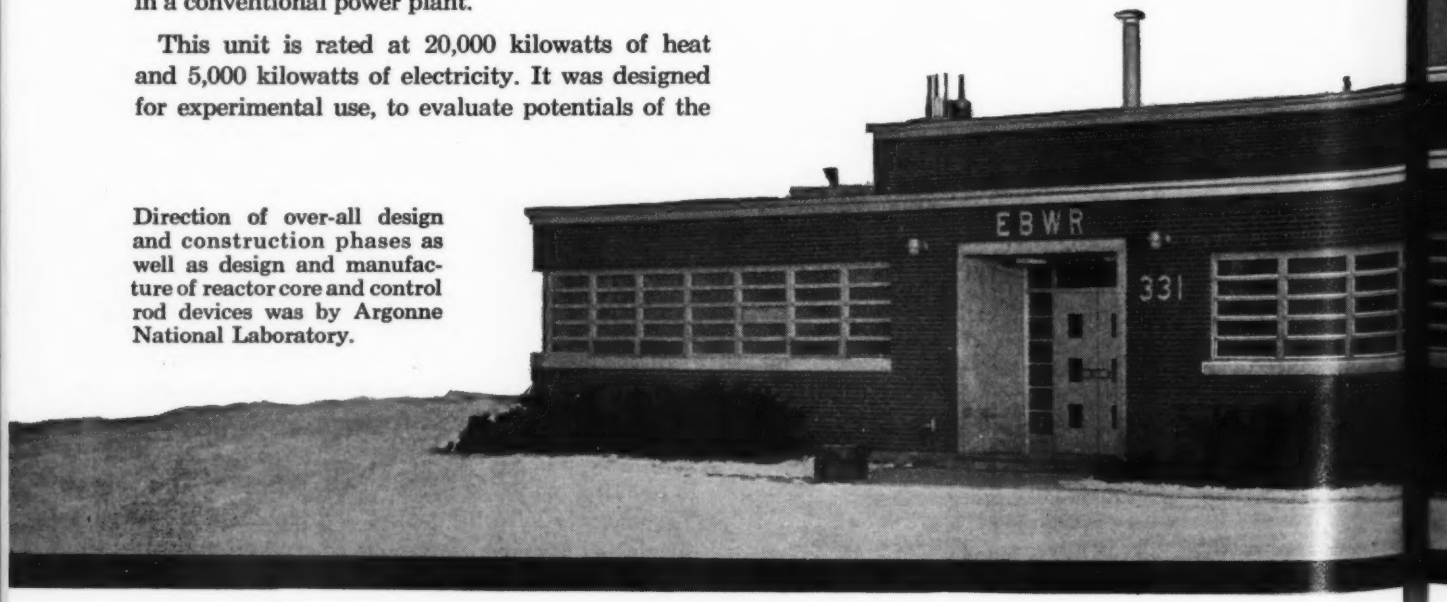
Electricity from NUCLEAR POWER TODAY!

NOW in operation at Lemont, Illinois, this is the first commercial-type power plant in the United States to generate usable quantities of electric power from nuclear fuels.

The unique feature of this boiling water reactor is that live steam is actually generated in the uranium core by nuclear heat and piped directly to the turbine without need for intermediate heat exchangers as required by other types of reactors. In effect, it operates very much like the coal-fired boiler in a conventional power plant.

This unit is rated at 20,000 kilowatts of heat and 5,000 kilowatts of electricity. It was designed for experimental use, to evaluate potentials of the boiling water reactor for large-scale commercial applications. Power generated is used by the Laboratory to meet a portion of its own electric power requirements.

Allis-Chalmers is proud of its association with this significant project. It's another example of "Engineering in Action" to provide power for better living from any source, whether it be water, steam, oil, or the atom itself.



Direction of over-all design and construction phases as well as design and manufacture of reactor core and control rod devices was by Argonne National Laboratory.

Power Equipment Supplied by Allis-Chalmers

- Steam turbine generator and exciter
- Surface condenser and air ejectors
- Complete control center for remote operation of reactor and power equipment
- Reactor water recovery and air drying system
- Reactor steam bypass control system
- Hermetically sealed pumps for reactor purification system
- Reactor feedwater pumps
- Circulating water pumps
- Auxiliary cooling water pumps
- Motor control centers
- Main and reserve power transformers
- Indoor and outdoor switchgear
- Automatic voltage regulator
- Circulating water treatment system
- Ac-dc distribution center
- Diesel-generator set

The Reader's Guide

The Committee of One-Hundred

On page 84, there is an article "How to Write Engineering Specifications." The authors of this article are a most important group. We asked prominent engineers from all branches of private practice and from all parts of the country to become part of a "Committee of One-Hundred." The members of this Committee have agreed to comment on selected topics put before them from time to time. The first topic selected has to do with the writing of specifications. We took the comments from these men and combined them. The result is a composite of their views. Few engineers will be able to read this article without getting many good ideas as to how their specifications could be improved. We also think that it is important that manufacturers and suppliers know how engineering specifications are written. We have reprinted this article as a booklet, and it is being mailed to about 2500 manufacturers so that they can understand the consulting engineer's point of view; so that they will know why their products are selected or rejected by an engineer. In the months ahead other topics will be put before the Committee and the comments will be published.

Nuclear Finance

Good bankers are more than casually interested in the opinions of engineers. Similarly, good engineers are much interested in the opinions of bankers. To be successful a project must be both technically and economically sound. The World Bank is most conscious of the need for sound technical advice on all projects for which they may make loans, and atomic power is one field in which technical skill and financial judgment must get together. For this reason the World Bank has on its staff an expert on atomic power. He is Corbin Allardice, and he has prepared for us an excellent article, "The Economics of Nuclear Power Plant Design and Operation," starting on page 76. It presents a picture of the current state of development of nuclear power as a commercial operation in this country and abroad.

Nosed out

The private practice of engineering has been growing at an astounding rate all over this country, but the West Coast is well ahead of the national average in number of new firms and expansion of older ones. Because of the importance of these West Coast engineers, we have started, this month, a new department which will appear regularly in CONSULTING ENGINEER. It is called "Report from the West Coast," and it is prepared exclusively for us by Ralph Torgerson, our Western Correspondent. Mr. Torgerson has been spending the past few months meeting consulting engineers in California, Oregon, and Washington, and he now knows what they are thinking and what they are doing. Whether your office is in Maine or Missouri, you will be interested in Torgerson's report on the activities of the fastest growing group of consulting engineers in this country. This month the "Report from the West Coast" (page 62) deals with an attempt by trade unions to get their labels on plans prepared by consulting engineers. It seems that this is being blocked for the present in California, but every engineer in the country should watch for local efforts of this type. Where such attempts are made, they should be reported to the state Society of Professional Engineers or to the state or regional Association of Consulting Engineers, or both. The law requires only the seal of a registered engineer on plans. The use of any other seals or labels is part of a "nose under the tent" movement. If, today, the union label is permitted on plans, tomorrow contractors may refuse to work from plans without the label.

Do It Yourself

If clients are plentiful, the same cannot be said for engineering employees. Arthur L. Spaet, of Slocum & Fuller, feels that the consulting engineer cannot afford to get into the salary race with the cost-plus government contract industries. He has found a better way. His solution is to train men in the office. Slocum & Fuller has set up a complete training course for both technicians and engineers, and they have solved the problem of maintaining a competent staff even in Manhanttan, an area where the competition for engineers is acute.

The Din of Falling Milkweed Seed

Sound and its transmission is one of the basic branches of physics, and as applied science, it unquestionably is a part of engineering. Yet, most consulting engineers have quietly avoided dealing with sound, leaving the field pretty much to manufacturers of sound equipment and those architects who think that owning a home hi-fi unit qualifies them to design a sound system for a theater or auditorium. Modern electronic sound systems are complicated affairs, and they require more than casual layout. Two of the country's few experts on sound systems are Harold Burris-Meyer and Lewis S. Goodfriend. They have prepared for us an article on "The Design and Specification of Electronic Sound Systems," published in this issue on page 70. It gives an idea of the design work required for a modern sound system project. Burris-Meyer and Goodfriend are publishing a book on acoustics in the fall, and this article will be incorporated as one of the chapters. Reinhold is the publisher.

Swedish Night Life

Our foreign report this month (page 108) is from Sweden. Etienne J. Guerin, our Swedish Correspondent, interviewed consulting engineer firms of all sizes and types. His report gives a good idea of how the engineers in Sweden operate. It seems that in Sweden there is not as much objection to the part-time engineer as there is in this country. While we usually refer to them as "sun-downers" or "kitchen-sink engineers," these men seem to be accepted as part of the profession in Sweden. There is enough work for all, and the part-time engineers cooperate rather than compete with the regular engineering offices. Anyway, that's what they tell us.

Milltown in Transition

One of the reasons for the rapid industrial growth of the South and Southwest has been the development, by real estate or financial groups, of large planned industrial areas. The nation's newest and largest area of this type is, quite naturally, in Texas, between Dallas and Fort Worth. In that great market area, 5000 acres are being made into a planned industrial area to be occupied by all types of light industry. A number of consulting engineers are being used in various aspects of the projects, but the first to go to work were Powell and Powell, civil engineers, of Dallas, who surveyed the area, prepared the grading plans, and designed the improvements, which included sanitary and storm sewers, water supply, drainage, and paving. Richard L. Powell is in charge of the project for his firm, and he tells how a job of this type should be handled, in his article, "Developing a New Industrial Area," on page 88.

Do Not Boil!

Steam has been used for process heating for so many years that many engineers fail to consider the use of high temperature liquids. The principal advantage of a high temperature liquid is the accuracy with which temperatures can be controlled. In many processes this is of vital importance. Bernard S. Breitman is an engineer who has studied process heating methods for many years, and here he tells other engineers something of what he has learned in his article, "High Temperature Heating with Liquids." It starts on page 96.

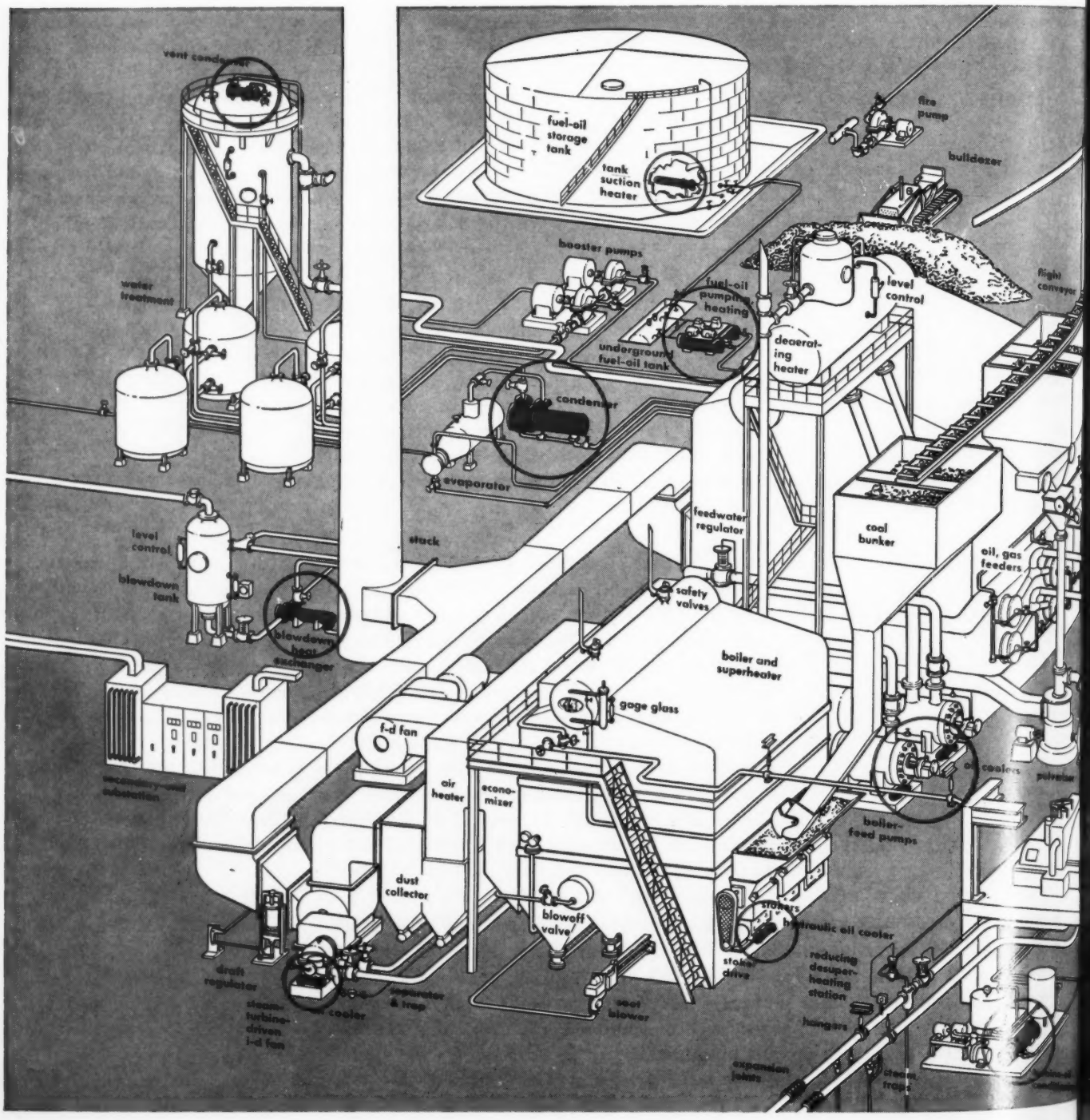
ROSS

Ross Exchangers and Condensers perform

This layout of a modern steam power plant could be yours today or a blue print of your future one. It could be a central station or an industrial plant. The interrelated equipment could represent all of your needs, part of your needs or more than you need.

From the standpoint of heat exchange and condensing equipment, however, this one fact stands out firmly: Regardless of the function and the condition, there's a Ross Exchanger and Condenser to meet *every* power plant requirement. See for yourself. Surface Condenser? It's there. Feedwater Heater? It's there. Blowdown Exchanger? It's there. Fuel Oil Heater? It's there. Now look over the machines and other equipment that require oil cooling — the Diesels, air compressors, turbines, transformers, boiler feed pumps. There's a Ross Exchanger to serve every one of them. The compressor cylinder-mounted intercoolers, the hydraulic oil coolers for the stoker drive, the jacket water coolers for both engines and compressors, the tank suction heaters . . . on it goes from one end of the plant to the other.

Where does the list end? It doesn't with Ross.



numerous services in the modern steam power plant

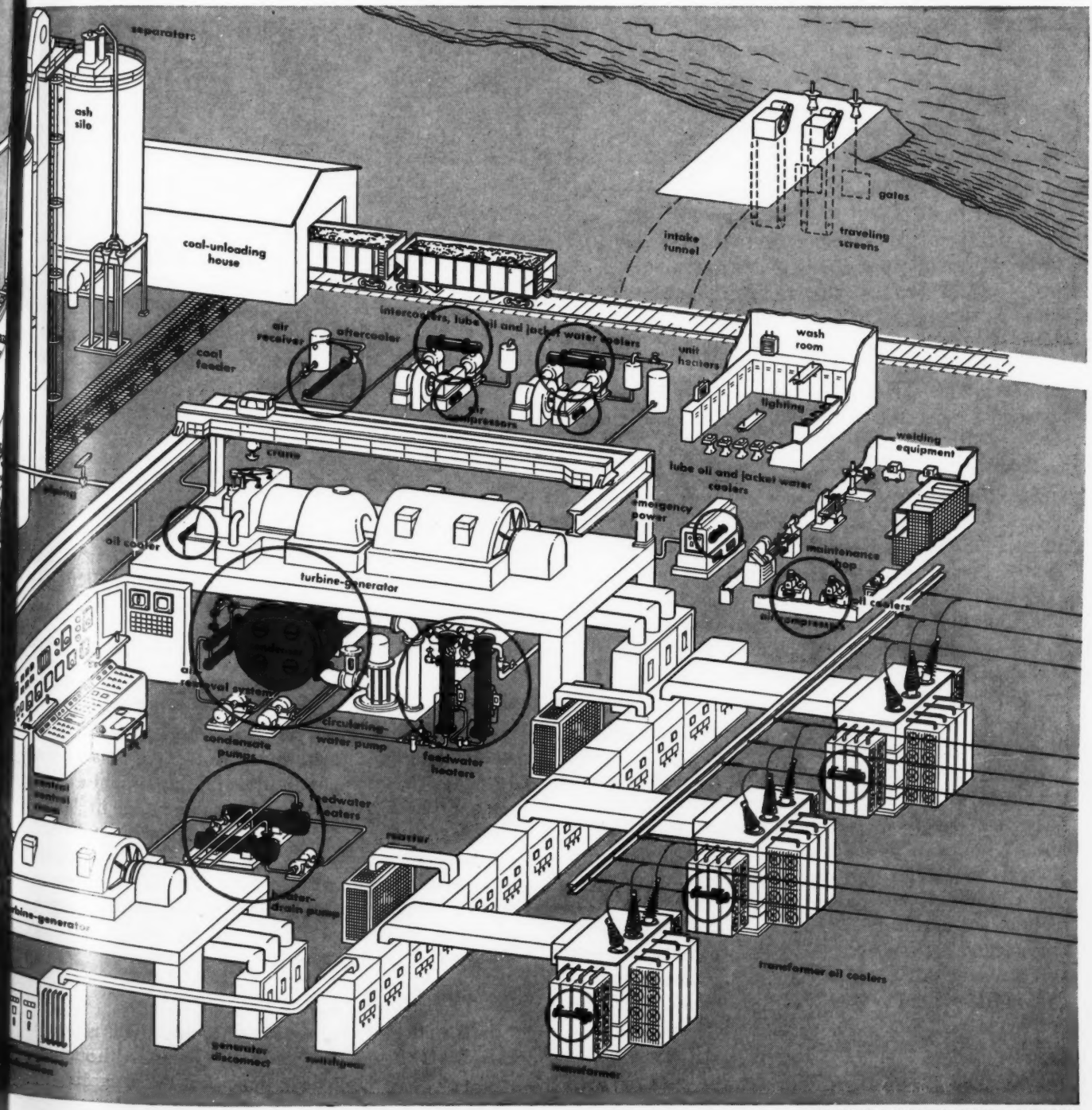
Standard or special, primary equipment or machine components, large or small, one of a kind or dozens alike, Ross Exchangers and Condensers are designed and built for optimum performance in every type of service within the modern steam power plant.

And of this you can be sure: A Ross engineer, in consultation with yours, not only has the most to offer in the way of equipment, but the most in experience, too. The name Ross is renowned in the power generation field — utilities, industries, institutions, major buildings, engineering and contracting firms throughout the world.

Complete literature on specific products will be mailed promptly at your request. Write: Ross Heat Exchanger Division of American-Standard, Buffalo 5, N. Y. In Canada: American-Standard Products (Canada) Limited, Toronto 5, Ont.

ROSS HEAT EXCHANGER

Division of AMERICAN-Standard



DRAWING COURTESY POWER MAGAZINE

The Legal Aspect

MELVIN NORD, P.E.
Consultant in Legal and Technical Problems
Patent Attorney

Atomic Energy Law (Insurance)

Financial Qualifications

Under the AEC licensing regulations (Sec. 50.33 f. published in *Federal Register*, Jan. 19, 1956), an applicant for a license must show that he has the "financial qualifications . . . to engage in the proposed activities . . ." This raises the question of whether such financial qualifications include the ability to respond in damages for public liability arising out of a catastrophic accident.

In fact, this particular question was raised at a hearing before the Joint Atomic Energy Committee (84th Congress, 2nd session, Part 1, Feb. 8, 1956, pp.107-114).

Rep. Cole: "I see the law does require the applicant to show or make a showing to the Commission of the applicant's financial qualifications. That is a very broad and indefinite and ambiguous expression . . . Your concern is whether the possible liability to damages for unexpected reasons is a facet of the financial qualifications."

Mr. Price: "That is the problem that we have not yet resolved."

Rep. Cole: "I can only say from my own standpoint, the question of financial capacity of the applicant to meet possible damages never entered my mind, but I thought the Commission ought to look into his financial qualifications. It was that the Commission be satisfied that the applicant has enough money to carry out the program. That is the affirmative part of the program, and not anticipating the harmful effects . . . If the Commission insisted on a showing of financial capacity to meet all damages, all possible damages, I doubt if you would issue any licenses at all, would you? . . . You might as well not even start, if you are going to require that."

Chairman Anderson: "Was not the real purpose of that section of the law to make sure that the operator of facilities or the user of materials would not skimp on health and safety measures, and common defense measures? We were not trying to make sure he would be able to pay all possible damages in the law."

The above discussion shows that the law is ambiguous. It has, however, been interpreted in practice so as to exclude the ability to pay all possible damages. Thus, new corporations are expected to be formed in most cases so as to limit liability to the amount invested. If injury claims exceed that amount and the company does not carry adequate insurance, the claims simply will go unpaid. Despite the fact that the Federal Government will be the legal owner of the fissionable materials which cause the injury, under most circumstances, if not all, it will have sovereign immunity from liability for such claims.

The Insurance Problem

No doubt, companies in the atomic energy business will want to carry all the public liability insurance they can get. However, it is impossible to obtain unlimited insurance protection, and since estimates indicate possibilities of catastrophic damage approaching a billion dollars in any one incident, the magnitude of the problem is clearly apparent. The insurance companies are simply not big enough to undertake risks of that type. Therefore, there is no way for an operator of a power reactor to provide adequate insurance protection for the public in the case of a catastrophe.

The Anderson Bill

In an effort to solve this problem, the Anderson Bill (S4112) was proposed last year. Although it was not passed, it will be reconsidered again this

INCREASED PRODUCTION *with* GREATER FUEL ECONOMY

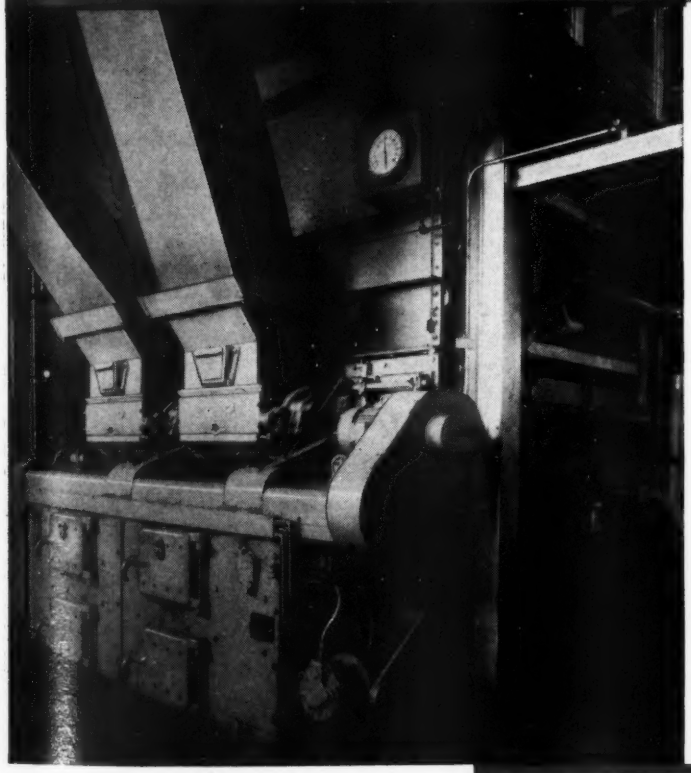
Smokeless Operation

DETROIT ROTOSTOKER TYPE C-C

(Continuous Cleaning)

at Carlisle Tire and Rubber Division

CARLISLE, PA.



It is not uncommon for the Detroit RotoStoker, Type C-C to make fuel savings ranging from 10% to 25%. Where process steam is used in production, as in this plant, fuel economy is usually accompanied by a substantial production increase.

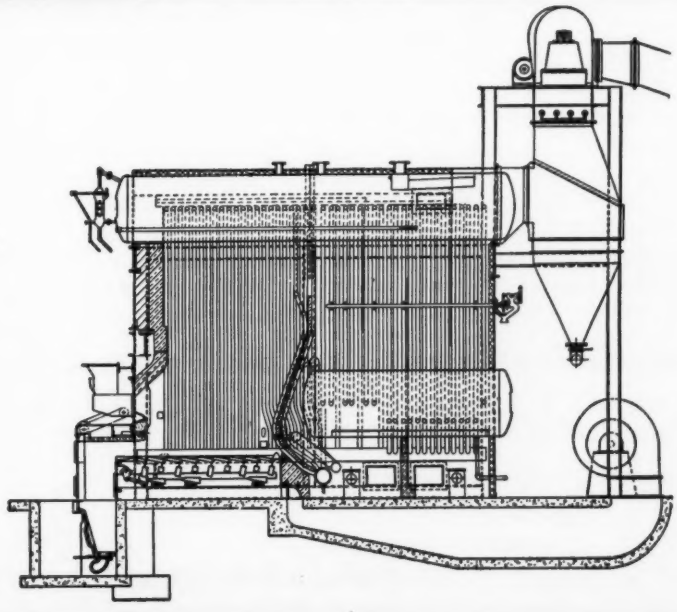
In addition the Type C-C provides smokeless operation at light loads as well as at full capacity—important in built-up areas.

Other advantages of Type C-C are:

- **Continuous uninterrupted steaming.**
- **Ample capacity and high availability.**
- **Quick response to load fluctuations.**
- **Fuel feeders and distributors handle high moisture coals without clogging.**
- **Available to develop 5,000 to 75,000 lbs. of steam per hour.**
- **Easily applied to new or existing boilers.**
- **Low Maintenance.**

Detroit RotoStoker Type C-C (continuous cleaning) in the plant of Carlisle Tire and Rubber Division of Carlisle Corporation. This unit has a capacity of 25,000 pounds of steam per hour. Either West Virginia or Pennsylvania 13,500 BTU coal is used.

Keeler Type CP Boiler with Detroit RotoStoker Type C-C. Ashes discharge at front, are removed by a conveyor. No basement is needed.



DETROIT STOKER COMPANY

MAIN OFFICE AND WORKS
MONROE, MICHIGAN

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year. It has been re-submitted as the Price-Anderson Bill (S 715; H 1981), with some improvements over the original bill, and is likely to be enacted into law eventually, in one form or another.

Principal Features

The principal features of the Anderson Bill, as amended, are:

¶ The requirement of financial protection by licensees — meaning "ability to respond in damages for public liability."

¶ Indemnification of licensees by the Federal Government, from public liability claims in excess of the amount of their financial protection, in the amount of $500 million for a single incident.

¶ The AEC will charge an indemnification or insurance fee of $30 per year per thousand kilowatts for Section 103 (commercial) licenses, and a discretionary fee for Section 104 (developmental) licenses.

¶ Limitation of liability of those persons liable for the losses, to the amount of their financial protection plus the indemnification, plus such other sums as Congress may make available.

Effect on Firm

Thus the A Corporation would be required by the AEC to provide a certain (as yet unspecified) amount of financial protection (meaning their own net assets plus insurance coverage). If their liability for a single nuclear incident exceeds such financial protection, the Federal Government would pay the balance up to an additional half billion dollars. If their liability exceeded even *this* limit, they would be exempted from the excess, except to the extent that Congress decided to make further sums available.

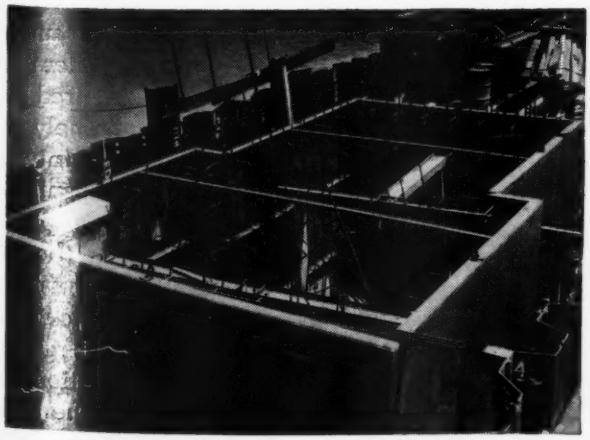
Questions Unresolved

This bill still has some serious difficulties in it:

The amount of financial protection required is not specified, and is likely to be extremely high so as to keep down the possible liability of the Federal Government. Otherwise, the government will be accused of taking over the insurance business. Although it is apparently contemplated that the government will try to re-insure this risk with private insurance companies, it is hard to understand how this can be accomplished, since the reason for the trouble in the first place is that the insurance companies are unable to take on such a risk. Furthermore, the cost of the government insurance seems very low. For a 100,000-kw plant like that being constructed by the Power Reactor Development Co. near Detroit, the fee would be only $3000 for a half billion dollars worth of insurance, when they are operating commercially, and an indefinite amount less than this during the developmental stages. Thus,

Protective scale which normally forms on the surface of wrought iron plates provides a long life additive for concrete substructures.

Bridge piers get low-cost protection against corrosion and spalling with Wrought Iron Plates



On new installations, wrought iron plates can serve in the place of forms for the concrete during construction.

Wrought iron pier protection plates stand up successfully to submerged and alternating wet-dry corrosion for extremely long periods of time.

The cost of such encasement is low in terms of protection for the concrete or other exposed structures. That's because wrought iron is such a reliable buffer against abrading or cutting action of water, floating objects and freezing and thawing.

We'd like to tell you more about wrought iron's saving in this service. Our booklet, *Wrought Iron for Bridge Construction*, contains illustrated case histories. Write for a copy. A. M. Byers Company, Clark Building, Pittsburgh 22, Pennsylvania.

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BYERS Wrought Iron Tubular and Hot Rolled Products

ALSO ELECTRIC FURNACE QUALITY STEEL PRODUCTS

in essence, what we have is virtually free insurance. Somehow, this just doesn't seem like the solution.

The difficulties of determining how much liability there is in any particular case will still remain, in view of the gross uncertainties of the tort law in this field. This may in itself be enough to put the company out of business simply on account of the magnitude of the legal fees.

The $500 million limitation is purely arbitrary. It is excessively high in the sense that it puts undue pressure on the AEC to require excessive insurance and other financial protection, but it is too low in that some claims may not be met by it.

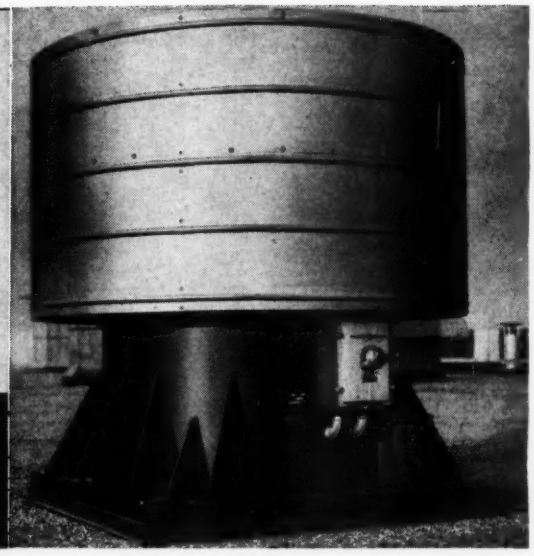
If the liability exceeds that provided for, there will be plenty of trouble. Although there will be apportionment, as in bankruptcy cases, it will take many years for the courts to decide all the cases. And in the meantime the problems involved in partial payment will be enormous.

Thus, it can be seen that the Anderson Bill is not the final answer. What really seems called for is some kind of Federal disaster insurance which would eliminate the lawsuits against the atomic power company.

Uncertainties

In the meantime, the uncertainty in the tort law renders the amount of insurance required and the insurance rates extremely uncertain. And the uncertainty in the ability of atomic companies to obtain enough insurance places further uncertainties on the desirability of being in this business too soon. If a new statute, or even a new AEC regulation is passed which affects these questions, it becomes a part of your operating license. Failure to abide by it means revocation of your license. Thus, being in the atomic power business at this time is truly a piece of faith in the United States Government. To all such businesses, we say, "More power to (and from) you!"

"Buffalo" Style "H" Sky Vent®



"Buffalo" Style "V" Sky Vent®

CLIENT SATISFACTION ASSURED WHEN YOU SPECIFY "BUFFALO" POWER ROOF VENTILATORS

HERE'S WHY:

1. **HIGH-VOLUME ECONOMY** — capacities to 250,000 cfm allow more air movement per roof opening — this means lower installation costs.

2. **HEAVY DUTY CONSTRUCTION** — with hollow steel tube framing, heavy gauge galvanized steel sheets and 1/8" thick cork impregnated asphalt coating both inside and outside. These units withstand corrosion, heavy snow loads and 100 mph hurricane force winds (25#/ft.^{2} wind load).

3. **EASY INSTALLATION** — Buffalo Sky-Vents® are delivered as complete packages — including motor, fan, housing, hood and curbing.

4. **LOW NOISE LEVEL** — fan design plus 1/8" cork impregnated asphalt coating reduces noise to a minimum.

5. **EFFICIENCY** — combined propeller, housing and hood design enables Buffalo Sky-Vents® to deliver more air per horsepower than other designs.

6. **THE "Q" FACTOR** — The Built-in Quality Which Provides Trouble-Free Satisfaction and Long Life. Write for Bulletin FM 2345 for details.

"Buffalo" Package Make-Up Air Units — Easily-installed "Buffalo" Package Make-Up Air Heating and/or Filtering Units deliver high volumes of make-up air . . . ideally suited for use with "Buffalo" Power Roof Ventilators. Bulletin FM 2345 covers this, too — write for it now.

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OPEN
I-T-E

Atoms in Action

THE LONG-AWAITED REPORT by the "three wise men of Euratom," Louis Armand of France, Franz Etzel of Germany, and Francesco Giordani of Italy, has been submitted to the six interested countries—Belgium, France, West Germany, Italy, Luxembourg, and the Netherlands. Titled "A Target for Euratom," it says that the six countries may be able to build over 15 million kilowatts of nuclear energy in the course of ten years, taking into account the help they can expect from Great Britain and the United States. The report listed only two types of reactors ready for commercial use: the U.S. pressurized water or boiling water reactor using slightly enriched uranium; and the British gas-cooled reactor fueled with natural uranium. The report thought two other types deserved future consideration; the British gas-cooled reactor fueled with slightly enriched uranium; and the heavy water reactor as developed in Canada. On cost, the conclusion was that electricity produced by either the American or the British reactor types would be about 11 to 14 mills per kilowatt hour, as against 11 to 12 mills for conventional power. These figures do not apply to reactors brought on line before 1962, which are considered to be prototype rather than commercial. (also see p. 76)

THE JOINT CONGRESSIONAL Committee on Atomic Energy after voting out the Anderson-Price bill 17 to 1 in favor, passed it on to the House and Senate on May 9. According to Anderson, the most important changes in the bill over its predecessor that died last year are three new sections. The first establishes a Committee on Reactor Safeguards appointed by the AEC to review safety studies and certain reactor license applications referred to it and make reports thereon. The second section provides that reports of the Safeguards Committee in certain specific applications be made public. The third section provides that the AEC shall hold a hearing upon 30 days notice and publication on certain reactor license applications. These have been added to the bill as amendments, incorporating into it another bill introduced by Anderson in this session. (See "Legal Aspects," p. 40)

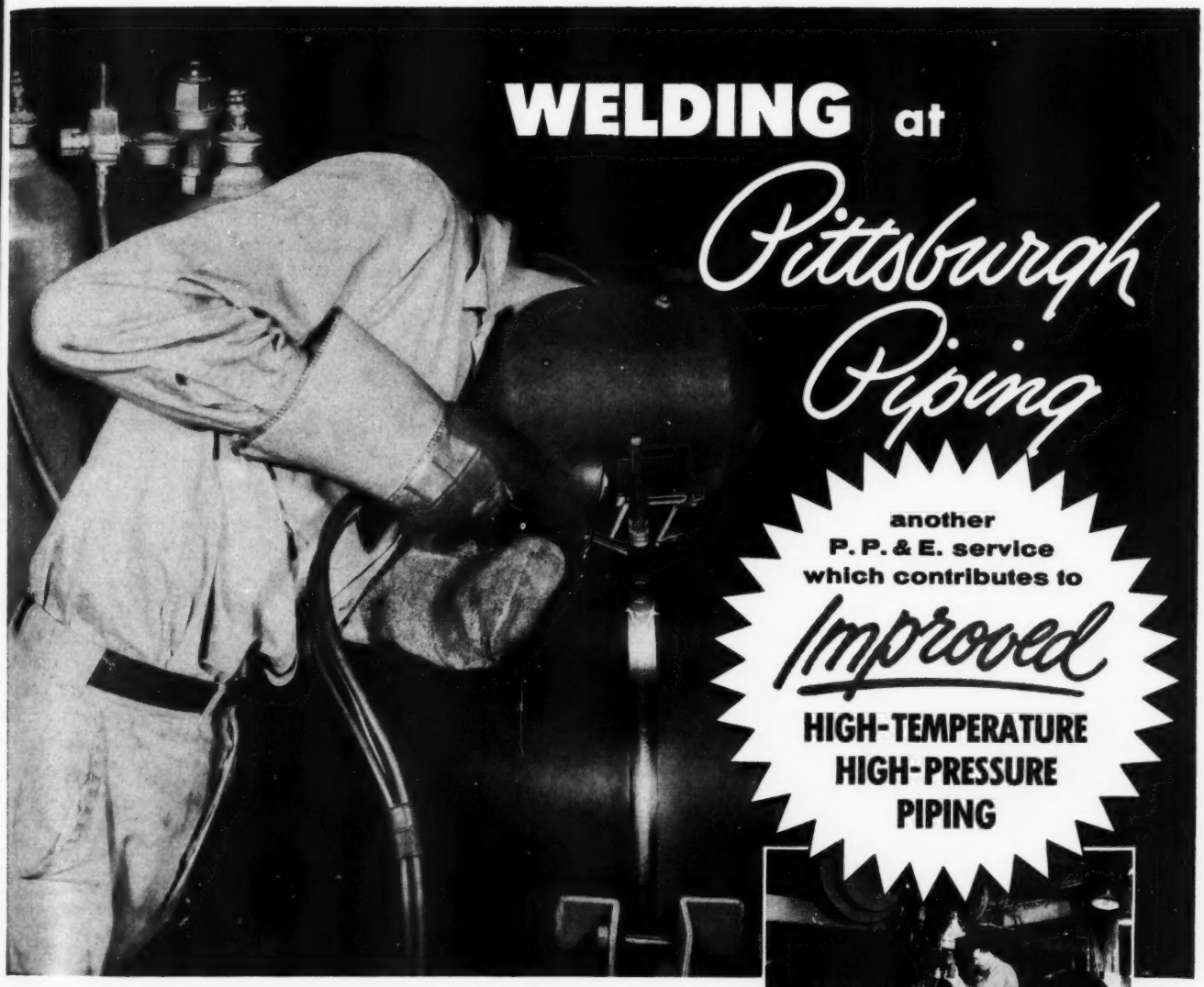
THE PHOENIX PROJECT, University of Michigan, has established a consulting group to advise the International Cooperation Administration on ways to promote peaceful uses of atomic energy throughout the world. The group will recommend types of atomic energy programs most suitable for other nations, evaluate proposals for technical assistance, prepare estimates on cost of facilities for training and research, survey atomic power possibilities, and assist in training and the dissemination of information. The group will work under a two-year contract with the ICA.

NUCLEAR ENERGY will supply most of the power requirements in Japan by the end of this century, according to Charles H. Weaver, Westinghouse, speaking before the Conference on Peaceful Uses of Atomic Energy, held in Japan. Reasons include scarcity of conventional fuels, limit on water power, and high demand for power created by rise in industrial production which has more than doubled since the war.

WALTER KIDDE NUCLEAR Laboratories has received a contract to perform consulting services on the Pennsylvania Advanced Reactor Project, sponsored by Pennsylvania Power & Light Company and Westinghouse Electric Corp., leading to the design of an aqueous homogenous reactor plant having an electrical output of 150,000 kw. Services by Kidde will include site survey and preliminary safety analysis, as well as extensions of studies initiated last fall on ventilation.

THE FIRST design contract to be let in West Germany for a power reactor has gone to Brown Boveri & Co., Mannheim, and Friedrich Krupp, of Essen. The 15,000-kw reactor, for Arbeitsgeneimschaft Dusseldorf (AVR), will be gas cooled and graphite moderated, using as fuel homogeneous pellets made of sintered uranium carbide and graphite. It will be controlled by changing the uranium load and the coolant flow, without use of steam and control rods. The concept is said to allow considerably higher operating temperatures (steam of 980 F) than any existing reactor. AVR is an association of nine utilities.

IF EURATOM comes into existence, it is possible that it will finance the experimental aqueous homogeneous reactor recommended for construction by the Steering Committee for Nuclear Energy of the Organization for European Economic Cooperation. It would be built at

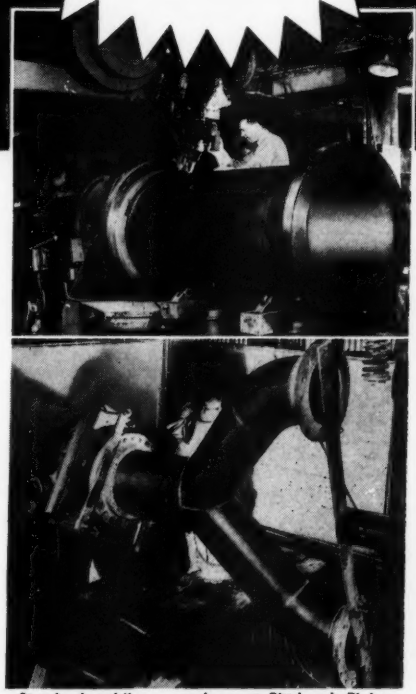


WELDING at Pittsburgh Piping

another P. P. & E. service which contributes to *Improved* HIGH-TEMPERATURE HIGH-PRESSURE PIPING

Modern power and process piping fabrication requires the highest degree of welding skill, as well as technical supervision which provides complete control of welding procedures. All Pittsburgh Piping welders and welding operators are performance qualified in accordance with Standard A.S.M.E. Welders' Qualification Test. They are specially trained in the exacting requirements of fabricating piping and related equipment for high-temperature, high-pressure central station service, corrosion-resistant applications, and nuclear power installations.

Fabricated high pressure boiler feed piping shop fabricated at Pittsburgh Piping. Comprises bends and forged laterals.



Standard welding procedures at Pittsburgh Piping are: Inert gas tungsten arc (above); automatic submerged arc (center); and manual metallic arc (bottom).

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Carbon Steel Piping	Forged Piping Materials
Cast Iron Fittings	Headers
Cast Steel Fittings	Manifolds
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Copper Piping	Stainless Steel Piping
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PP-20

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Winfrith Heath, England. Funds would come from the $250 million Euratom reportedly will put aside for research.

IT IS POSSIBLE that conventional methods of petroleum refining at some time in the future may be replaced by completely new methods, according to M. J. Rathbone, president of Standard Oil Co. (New Jersey). He pointed out that work of Esso Research & Engineering Co. with gamma radiation sources has actually produced gasoline from heavier oil stocks and from refinery gases in laboratory tests.

AEC COMMISSIONER Willard Libby, speaking on the sodium cooled reactor in the submarine Seawolf, said that even with satisfactory heat exchangers, the light sodium system does not prove to have the weight and performance advantages for shipboard use that originally were hoped for. He reiterated just about everyone else's statement on the Seawolf troubles that "the troubles are rarely with the nuclear reactor itself, but are usually with the non-nuclear equipment associated with it."

THE ARMY's "on again, off again" Food Irradiation Reactor, if constructed, would have a core surrounded by a vessel containing a solution of indium sulphate, which can be activated very readily by neutrons. The activated indium in turn would decay rather rapidly emitting gamma rays. In this way, a mechanism would be provided for converting neutrons in the reactor to pure gamma rays free from neutrons in an area external to the reactor proper.

THE U.S. CHAMBER OF COMMERCE has issued a policy statement on nuclear power development that calls for private industry to construct and operate power plants as soon as research with new concepts or designs develop to the point where additional prototype or large-scale nuclear plants appear feasible and desirable. The statement also urged amendment of the Atomic Energy Act of 1954 to provide a non-discriminatory means for disposal of electric energy instead of as now prescribed by Section 44.

PRIMARY PHYSICAL problem in construction of the Army Package Power Reactor, built by Alco Products, centered on the vapor container. The empty shell had to be pressure and leak tested before any interior work could be started. In addition, equipment had to be installed through an equipment loading hatch at the top of the container — some 80 feet above the ground.

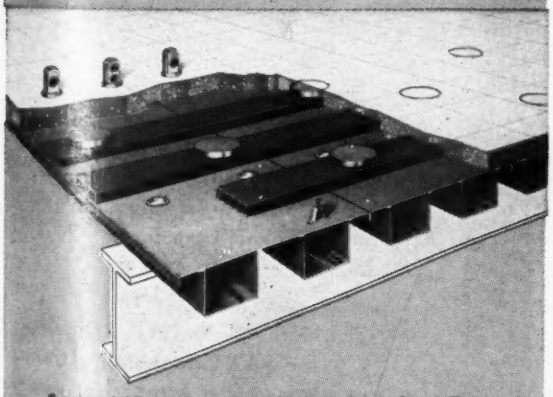
THE UN ADVISORY COMMITTEE on the Peaceful Uses of Atomic Energy has decided to hold the second International Conference in Geneva, Switzerland. Dates are September 1-13, 1958.

INTERNUCLEAR CO., of Clayton, Mo., has been engaged for consulting and engineering services on the large-scale nuclear power plant planned by Societa Elettronucleare Nazionale (SENN) of Italy. Internuclear will assist in selection of reactor type, design, training of operating personnel, and start-up of the completed reactor. SENN was organized

M-FLOORS . . .

Selected to Meet Electrical Demands in Modern Insurance Office Building!

The construction view above shows Mahon M-Floor installation in a modern Four Story Office Building for Kansas City Life Insurance Company, Kansas City, Missouri. Mahon Long Span M-Deck was employed in the Roof Construction. Edward W. Tanner & Associates, Architects. Collins Construction Company, General Contractors.



Sectional View of an Electrified Cellular Steel Floor Constructed with Mahon M-Floor Section M2, and Energized with a Three Header Duct Electrical Distribution System. Mahon M-Floor Cel-Beam Sections are available with either Two or Three 6" wide Cel-Beams in a 24" width, and in several Beam Depths to meet virtually any structural requirement.

In a four story addition to the Kansas City Life Insurance Company's home office building in Kansas City, Mahon M-Floors were selected to meet the unusual live load requirements of 180 lbs. per sq. ft., and to provide the additional electrical raceway capacity required for the myriad electronic business machines and the countless telephone and intercom circuits common to the insurance business. This building, shown under construction above, is a unique design in that it provides for 50 ft. clear span laterally between outside columns on all floors. The Mahon M-Floor Section employed for the structural sub-floor was placed on simple spans of 16'-3". It provided a flat plate upper surface with Cel-Beams of 6" in depth. Electrically, this Mahon M-Floor Section provides Cel-Beam Raceways 6" x 6" on 1'-0" centers under the entire floor area. These 6" wide Mahon Cel-Beams provide the extra raceway capacity needed for this type of occupancy, and permit greater latitude in the location of floor service fittings . . . they also permit the use of 4" diameter access hand-holes between Electrical Header Ducts and the Cel-Beam Raceways—this greatly facilitates fishing for wires and wire pulling when changes in electrical circuits or additional circuits become necessary. High or low Potential Floor Service Fittings can be installed wherever required in every square foot of floor surface throughout the building. When you select an electrified steel sub-floor for your next building, you will want all of the structural and electrical advantages that have been engineered into Mahon M-Floors. Comparison will convince you that the basic functional requisites of a Cellular Steel Sub-Floor are more fully realized in the design of Mahon M-Floor Cel-Beam Sections. See Sweet's Files for information, or write for Catalogue W-57.

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Manufacturers of Electrified M-Floors; Steel Roof Deck and Long Span M-Decks; Acoustical and Troffer Forms; Concrete Floor Forms; Insulated Metal Walls; Underwriters' Rated Fire Walls; Rolling Steel Doors, Grilles, and Underwriters' Labeled Automatic Rolling Steel Fire Doors and Fire Shutters.

MAHON

recently by Finelettrica, a utility holding company.

ADEQUATE CONTAINMENT adds less than five percent to the cost of nuclear power reactors, according to Dr. Walter H. Zinn, president of General Nuclear Engineering Co., speaking before the Inter-American Symposium at Brookhaven.

THE NEW YORK CENTRAL Railroad's new $1 million technical research center in Cleveland will make wide use of radioactive isotopes for wear studies, measuring durability of paint, development of improved signals, and radiographic inspection of rails. The center now is studying new types of kyrpton-85 and tritium activated phosphor switch lamps that are planned for use in new automatic switch yards. They will save the cost of thousands of feet of cable.

PENN-TEXAS has an AEC contract for development of a new method for fabrication of complicated metal shapes by powder metallurgy, with elimination of presses entirely.

THE DEVELOPMENTAL Boiling Water Reactor at GE's Vallecitos Laboratory in California will use an initial core consisting of fuel elements made from fully enriched uranium oxide plates clad with stainless steel, followed by a second core made from zirconium or possibly stainless steel tubes containing pellets of 2.3 percent enriched uranium oxide. The pressure vessel will be about seven feet in diameter and 20 feet high, with a pressure capacity of 1000 psi. The reactor will have a secondary steam generator and recirculating loop to test dual-cycle and forced circulation methods. It will generate 20,000 thermal kw.

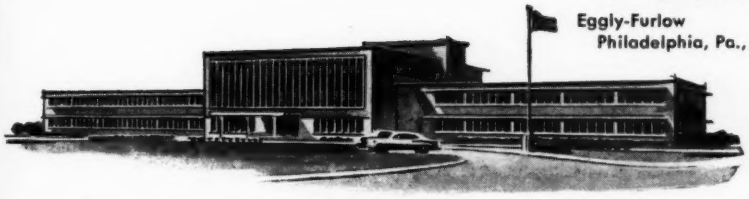
NUCLEAR POWER GROUP reported to the Joint Congressional Committee that on the basis of a study conducted in cooperation with Babcock & Wilcox on the homogeneous reactor, the type holds great promise but there is a serious question as to whether it is ready to be built on a full-scale basis.

COST OF POWER from the pressurized water reactor with oil-fired superheater under construction at Indian Point, N.Y., by Consolidated

Shirt-sleeve comfort in the window-wall area

Whiteside-Moeckel-Carbonell
Wilmington, Del., *Architects*

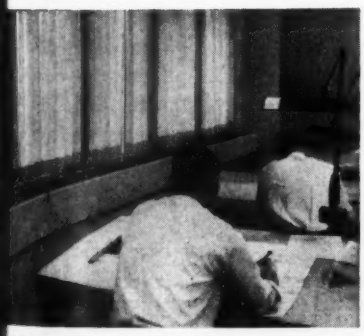
Eggly-Furlow
Philadelphia, Pa., *Engineers*



FOR ATLAS POWDER CO.
WILMINGTON, DEL.

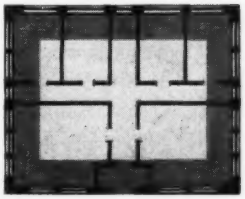
Sill-line puts all space to work!

In many window-wall buildings with central fan systems, the outer borders must be written off as an unproductive area . . . workers avoid these frigid zones because of the cold window problem. But in the general offices of Atlas Powder Company, each floor is 100% usable because Nesbitt Sill-line places heat along the cold windows to combat chilling downdrafts and protect against excessive loss of body heat to the cold surfaces. Nesbitt developed Style G Sill-line for this specific purpose. Its low-capacity, finned-tube radiation forms a blanket of protection whenever and for as long as needed—making the window zone a desirable place to work.



Men at work—with no threat to comfort

It's pleasant along the daylight perimeter



SILL-LINE SAVES THE MOST VALUABLE WORKING SPACE . . . AT THE PERIMETER OF THE BUILDING

Figure it as you please . . . without cold window protection you can lose 10 to 20% of working space . . . with it you can save as much in construction cost.

Nesbitt Sill-line is high-capacity finned radiation in a beautiful modern enclosure; five cabinet styles; seven standard lengths; steam or hot water; 700 to 2900 Btu/lin. ft.; one-piece back panel; quick, easy installation; every needed accessory available.

SEND FOR PUBLICATION 102

Nesbitt

SILL-LINE RADIATION

Made and sold by John J. Nesbitt, Inc., Philadelphia 36, Pa.

Edison, is presently estimated at 12 mills per kwh, compared with 7.5 mills for the new conventional unit under construction at Con Edison's Astoria, N.Y., plant.

THE INTER-AMERICAN Committee of Presidential Representatives has recommended to the governments of 21 American republics that an Inter-American Commission on Nuclear Energy be established with the Organization of American States. OAS secretary general Jose A. Mora set the first task of the Commission as a hemisphere-wide study of the needs and capabilities of the American nations for peaceful uses of the atom.

INDUSTRY IS SAVING NEARLY $400 million annually through the use of radioisotopes, said E. Eugene Fowler, deputy director of the AEC Division of Civilian Applications, at the Industrial Nuclear Technology Conference. Capital expenditures for facilities and equipment to use radio isotopes need not be large, in many cases not exceeding $5 to $10,000, according to Fowler. An average-sized foundry can set up to use isotopes for non-destructive testing purposes for less than $5000. However, to install a beta ray density gage for controlling the thickness of a product, such as plastic, rubber, or sheet metal, the investment may be as much as $25 to $30,000.

DR. ALVIN M. WEINBERG, director of AEC's Oak Ridge National Laboratory, revealed that in 1954 Oak Ridge successfully operated the Aircraft Reactor Experiment, a circulating fuel, extremely high-temperature reactor in which the fuel was a mixture of molten fluoride salts containing UF_4. The moderator was beryllium oxide. The reactor was designed to operate at 1500 kw, but actually ran at a peak output of 2500 kw. What makes the report particularly interesting is that as short as the operation was (about four days and nights at full power) it demonstrated extreme stability and responsiveness to power demand, making it a possibility for civilian applications. Problems included keeping the pipes heated to prevent solidification of the fuel mixture (which freezes at 500 C) and maintaining absolute leak-tight conditions. Weinberg expressed the opinion that chemical type reactor systems

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With the increasing trend to copper-lined water heaters for rust-free water and low maintenance, P-K has compiled for you complete data on this type of heater. Complete specification outline, construction details, heating capacities, engineering and installation data, plus many other needed facts are all contained in this compact, concise, easy-to-use file. A copy is yours for the asking. . . . Mail the coupon today. The Patterson-Kelley Co., Inc., 127 Burson Street, East Stroudsburg, Pa.

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might offer the simplest way to achieve economic atomic power by burning U-235 in very high temperature devices similar to the ARE, in which the fuel is liquid.

THE REDUCED-SCALE reactor acceleration program proposed by Rep. James E. Van Zandt in House Bill HR 7472 would authorize appropriation of $100 million for construction, at AEC sites, of advanced design and development reactors of 50,000 kw or less. In addition, the bill would give additional statutory authorization for AEC to enter into contracts for conduct of research and development required in construction of prototype power reactors. It would limit government financial assistance to no more than the difference between cost of the nuclear plant and cost of a conventional plant. And it would provide tax relief by amending the Internal Revenue Code to include atomic power reactor demonstration facilities in the definition of "emergency facilities" eligible for possible tax amortization deductions.

TWO FORMAL PROPOSALS have been submitted to AEC under the third round of its Power Demonstration Reactor Program. The first came from the Florida Nuclear Group, which plans to build a heavy water moderated, gas cooled reactor fueled with natural uranium, with a capacity of 136,000 kw. Cost is estimated at $40 million. Dr. Walter Zinn's General Nuclear Engineering Corp. has been engaged to design the reactor and carry out research and development work. The second proposal came from Northern States Power Co., Minneapolis, and ten associated companies, who are planning a 66,000-kw plant incorporating a controlled recirculation boiling water reactor using slightly enriched fuel. Cost of this plant is estimated at about $21 million. Pioneer Service & Engineering Co. will be architect-engineer on the plant.

INDUSTRY'S RELUCTANCE to invest capital in nuclear installations is due to lack of uniform standards in the field, according to Morehead Patterson, of American Machine and Foundry Co. As chairman of the Nuclear Board of the American Standards Association, he urged industry to get behind ASA's efforts to achieve standardization.

WHY CONSULTING ENGINEERS GIVE WESTINGHOUSE TOP RECOGNITION

In an impartial survey of brand recognition, conducted nationally by a leading construction industry editorial group, Westinghouse ranks top choice with consulting engineers year after year. There are several important reasons . . .

Everything you call out in the way of electrical apparatus can be specified from one source—Westinghouse. The type of product engineering assistance we make available anywhere in the nation is designed to supplement and simplify your important role as consulting engineer.

Reliance on this one source pinpoints responsibility and solves two important problems in client satisfaction . . . Your specifications are precisely matched . . . Construction schedules are easier to meet, with dependable deliveries. DP-5036-A

A few "In Use" examples on following Pages Illustrate why

YOU CAN BE SURE...

IF IT'S

Westinghouse

Simplify "Consultant with Switchboards

Comprehensive application and cost data on every type of Westinghouse apparatus are available for your files. Their technical accuracy can help you to detail clean-cut, soundly engineered jobs, with profits for all concerned.

For instance, Westinghouse switchboards are unit built from standard components. Panelboards can be ordered completely "packaged" to your circuit specifications or simply assembled on the job with standard "block building" units. All can be laid out to fit any type or size of job, in terms that make it a cinch for your contractor to "complete as specified."

DP-5036-C

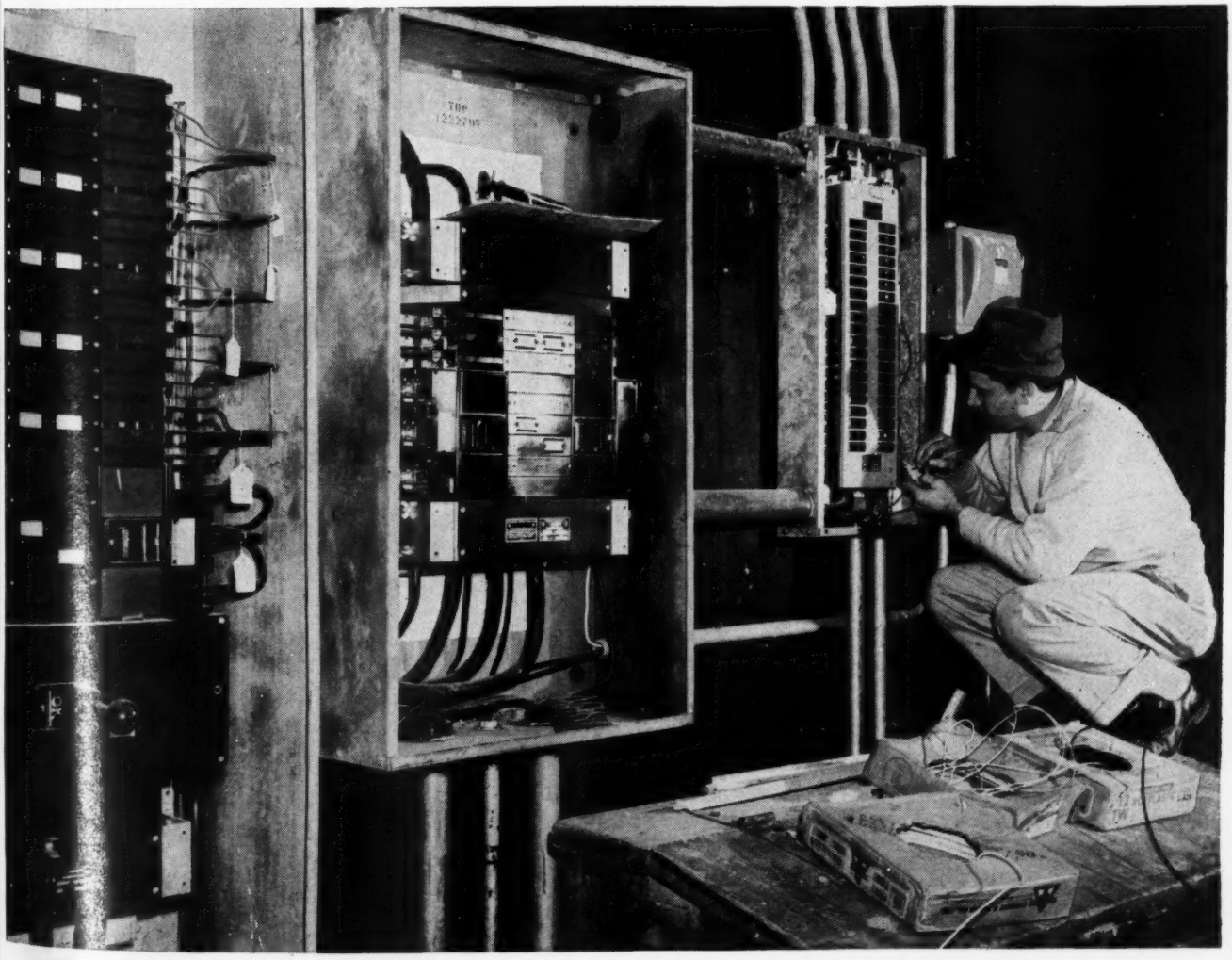
It was a contractor who gave us one of our best punch lines . . . "A good point about Westinghouse equipment," he said, "is the way it fits the job. Panelboards and switchboards, for instance. They go together like ham and eggs. They are all ready to hook up when we get them and they fit the job easily."

That's our point for today. For bread-and-butter details ask for bulletins SA-7433 and BA7016.

WESTINGHOUSE BUILDING-TYPE SWITCHBOARD (Left) . . . Dead-front construction assures complete safety in operation. Prewired assembly at the factory makes installation fast—keeps costs low.

Relations"
Westinghouse
and Panelboards

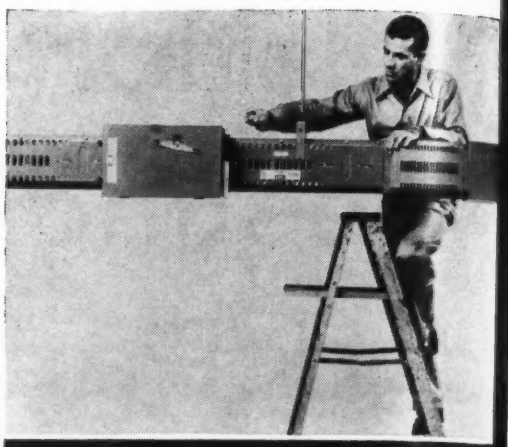
Westinghouse distribution panelboards and Add-A-Cirkit panel at far right. Ample space for wiring makes installation and connections easy and fast. Westinghouse De-ion® breakers assure positive circuit protection. DP-5036-B

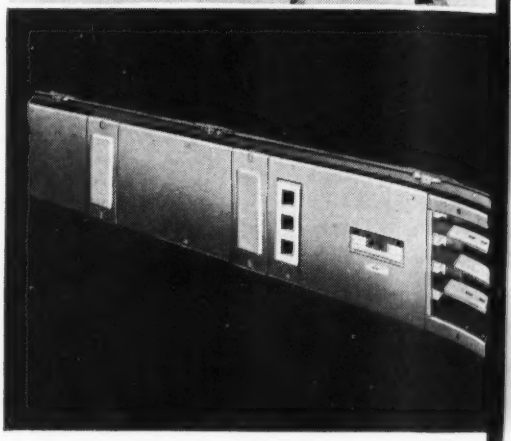


YOU CAN BE SURE...IF IT'S Westinghouse

THE "EXPRESS" BUS FOR POWER DISTRIBUTION

Simple to install, safe to wire, economical to use

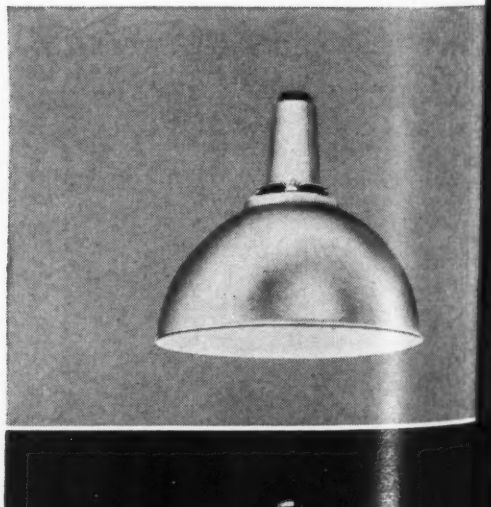




Westinghouse bus duct truly is the "express" medium for power distribution. In conventional Westinghouse plug-in duct, outlets are spaced every 12 inches giving the ultimate in design flexibility for plant layout. With Westinghouse low-impedance bus duct long runs can be laid out with a minimum of concern over voltage drops.

New Life-Line Uni-Bus combines the features of low-impedance and plug-in duct in one busway. The unique flexible connector and safety devices add up to make Uni-Bus industry's most outstanding busway system.

Most Consulting Engineers know why...



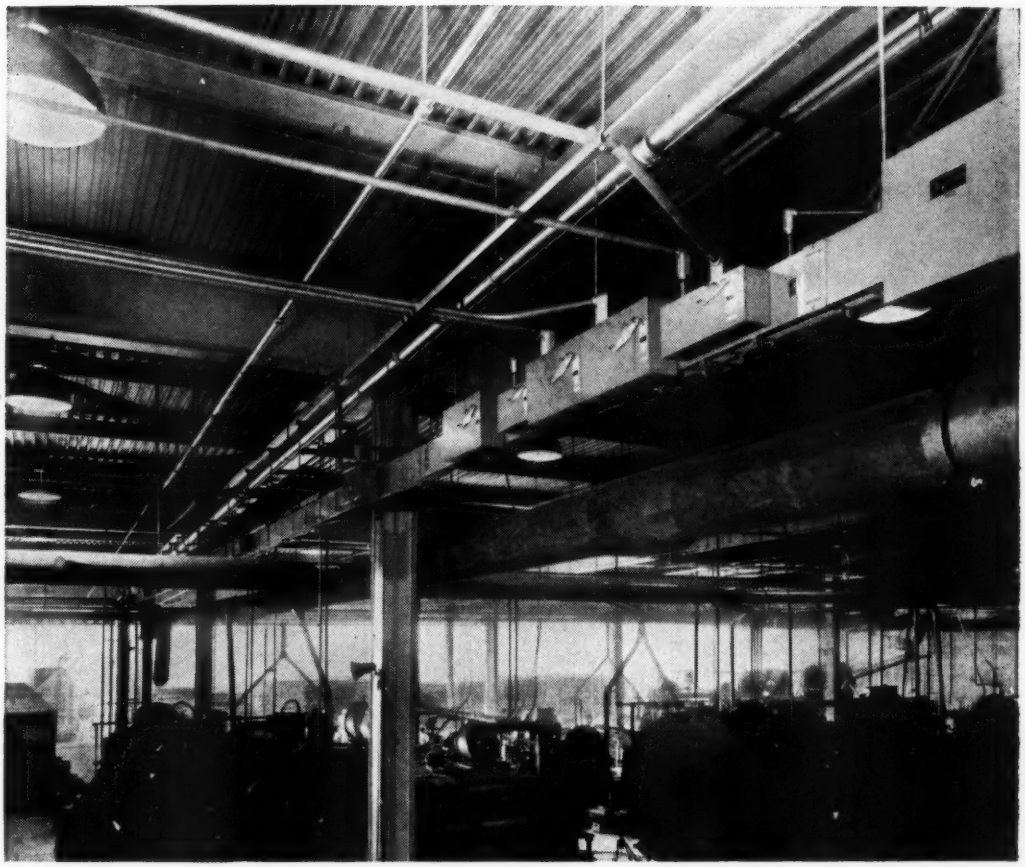
LIGHT IT RIGHT WITH WESTINGHOUSE

Because of carefully engineered design, there are Westinghouse fixtures to help you get the right light on every industrial situation. Right from the standpoint of proper levels of illumination for safety and efficient working conditions. Right from the maintenance man's viewpoint: less work for his crew, less overhead charged against his department. Right also in long-range cost... installation, maintenance, and ratio of light-per-watt expense in operation.

There are Westinghouse technical bulletins to cover every type of lighting problem. Ask for a set for your work file, through your local Westinghouse Lighting Engineer or directly from . . .
Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pa.

DP-5036-D

Section of Life-Line Uni-Bus showing interlocked plug-in safety slide.



This installation shows Westinghouse plug-in duct used as a branch circuit supplying power to several machines. Easily changed take-off devices allow the relocation of any machine without power shut down to the others.

For complete information on Westinghouse Bus Duct or Uni-Bus, write for New Bus Duct Manual B-4272-C.

YOU CAN BE SURE...IF IT'S Westinghouse

VENTILATED HIGH BAY

The industrial plant pictured here is lighted right for efficiency, safety and economy with Westinghouse equipment similar to the high-bay fixture at left. Self-cooling, rugged, easy to keep clean. It lights right and lasts long.

LOCKLITE: This sturdy incandescent fixture has a wide variety of industrial applications. Exclusive Locklite feature simplifies cleaning of replacing lamps. Wide reflector gives effective light distribution.

Ask your local Westinghouse representative for descriptive bulletins relating to the types of lighting that fit your needs.

DP-5036-E

Report from the West Coast

RALPH S. TORGERSON
CONSULTING ENGINEER CORRESPONDENT

WILL THE TRADE Union Camel get his head in the professional engineers' tent? A hearing before the Los Angeles Board of Public Works on April 3 has aroused professional engineers on the West Coast to the growing pressure of a trade union to embrace all professional employees within its fold. This is not being done so much by direct action, but through the insidious and more subtle method of requiring the placing of the union label on all engineering and architectural plans. The hearing by the Board grew out of the question of the propriety of members of the American Federation of Technical Engineers placing a union stamp on engineering plans and drawings presented to the City Engineer.

Some very interesting and frankly spoken views were expressed at the hearing. The union representatives tried to assuage any fears of secondary boycotts or other high pressure action by playing down any significance to the use of the union label other than as an innocent emblem of pride in workmanship and fair working conditions. The union representatives themselves in their plea promised that the American Federation of Technical Engineers and members of the Central Labor Council would not make any requests or efforts to have workmen on construction jobs and others handling these drawings refuse to conduct usual work because they do not have the union label. William Gilbert of the national AFL-CIO was the principal speaker representing union labor. Ted Brand, speaking on behalf of the Los Angeles CIO Industrial Council, charged the opposition to the use of the union label with being antiunion.

Pecos H. Calahan, executive secretary of the Consulting Engineers Association of California, presented a very clear-cut statement of the Association in opposition to the placing of any insignia on engineering plans other than that required by law. The statement outlined four fundamental principles:

¶ Under the laws of the State of California, the responsibility for engineering designs and plans is vested in the registered engineer signing the plans and no other individual or organization has any responsibility therefor, and any additional insignia or information on the plans would imply that there was divided responsibility.

¶ Engineering plans are a result of professional attainment and preparation, and any unnecessary stamp, label, or other similar marking has no significance as to the competency of the designer or the adequacy of the plans.

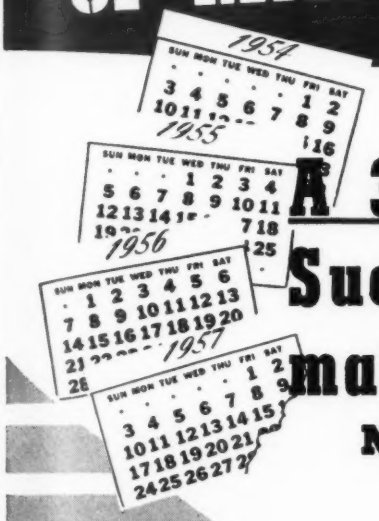
¶ The only purpose of any insignia on the plans, other than the signature of the registered engineer, would be to advertise an organization, and it would not be appropriate that such advertising appear on engineering plans or public records.

¶ If the practice were permitted, the end result would be the placement of innumerable insignia of various organizations on the plans, resulting in confusion and detraction from the main purpose of the engineer's plans.

Ralph Westcott, president of the Consulting Engineers Association of California, also appeared for the Association and backed up Mr. Calahan's statement by concurring in its conclusions.

Pat O'Donovan, secretary of the Construction Industries Committee and the Engineering and Architects Consultant Committee of the Los Angeles Chamber of Commerce, in his opposing testimony said, "It is our understanding that the State Board of Registration for Civil and Professional Engineers have ruled it is not consistent with the state law regulating the practice of professional engineering for any data, material, or information to be placed on an engineering drawing, plan, or document that

When the Job Calls for AIR or MATERIALS Handling...



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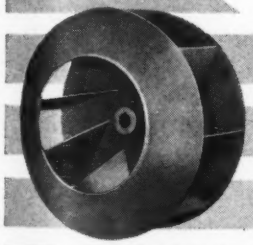
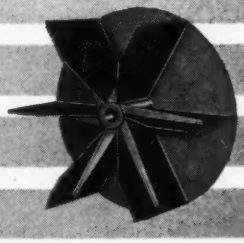
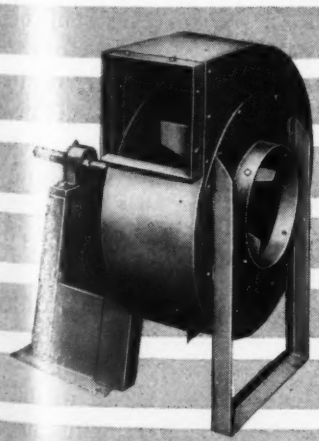
your logical choice!



Bayley Style "AH" Air-Handling Wheel



Bayley Style "GP" General Purpose Fan



Bayley Standard Type "EX" Fan

Engineered Air-Handling Equipment

With a performance record extending over a period of three years, since the introduction by BAYLEY of the Type "EX" Fan, a story of outstanding success in a wide variety of applications has proved the dependability and efficiency of this precision-built equipment.

FEATURES LIKE THESE . . .

Show WHY "BAYLEY" Fan Installations Provide Peak Performance . . .

- **PRECISION COMPONENTS** — for Maximum realized fan efficiency
- **STANDARD BASIC DESIGN** — readily modified with standard accessories to meet any special application
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WRITE For Complete Bayley "EX" Fan Manual Today

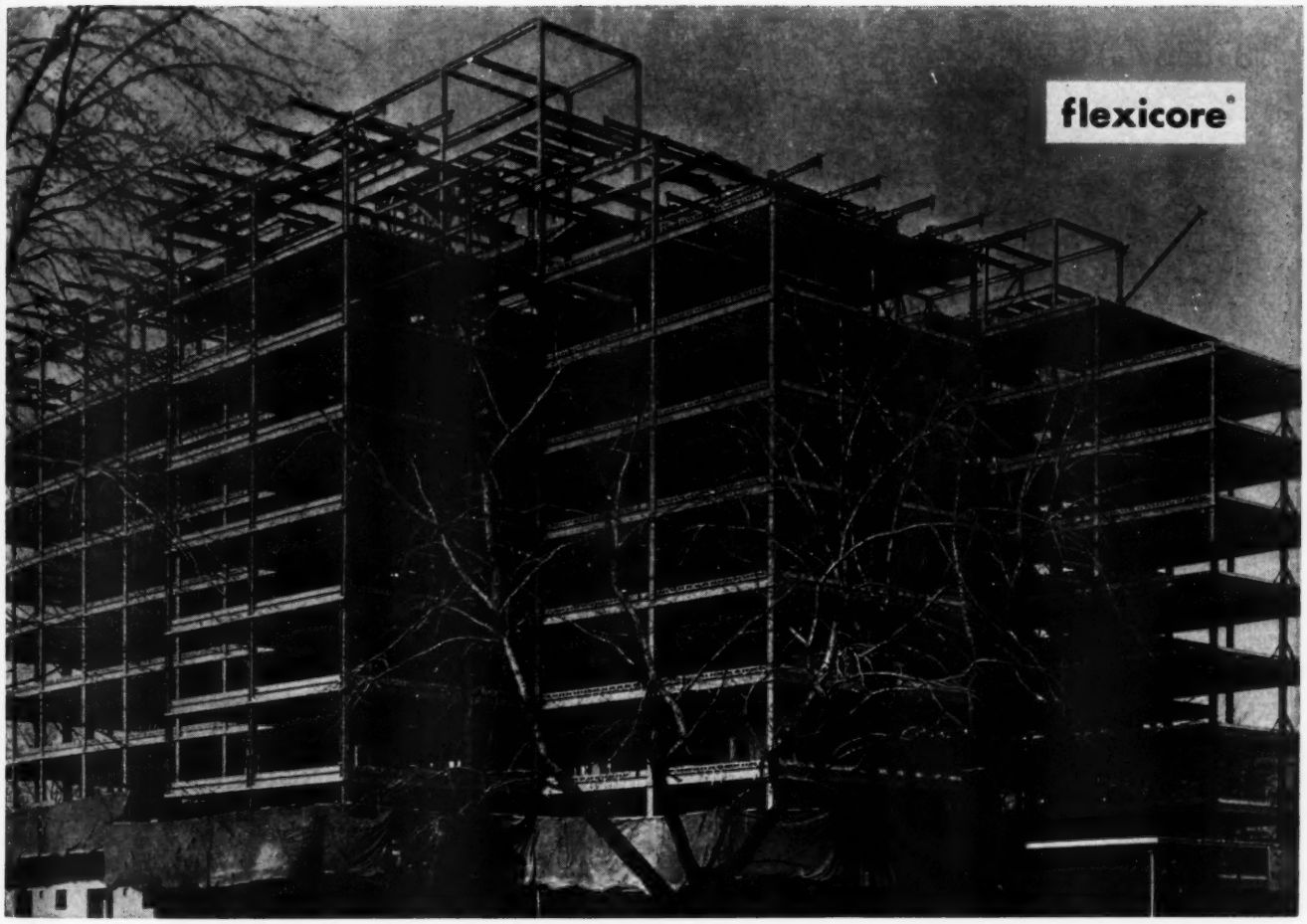
Bayley BLOWER COMPANY

is not directly pertinent to the construction . . . for which the plans have been prepared."

C. R. Leslie appeared as attorney for the Merchants and Manufacturers Association of Los Angeles in opposition to the use of the union label on engineering plans. He pointed out that while there might be some justification for the use of a union label on consumer goods, like clothing and bread, as it might promote its sale as consumer's goods, the union label is not used for the purpose of aiding in the sale or consumption of the drawings. He charged that the union label is used in most cases as a trigger for secondary boycotts, and he felt there was evidence in the case before the hearing of an attempt to inject collective bargaining into the City municipal government. Mr. Leslie also cited attempts made by the American Federation of Labor to require city, state, and county governments to bargain collectively and permit unions to strike against such agencies. He said that if you put the two things together, the union label on the drawings and the right to strike, you will soon arrive at the conclusion that they desire the right to engage in a secondary boycott and to have their members refuse to do work in connection with drawings that do not bear the union label.

Architect's Viewpoint

C. M. Deasy, president of the Southern California Chapter of American Institute of Architects, said that architects and professional engineers are licensed by the State of California and are authorized to identify professional work by affixing to drawings their signature and seal. No other insignia, he pointed out, can relieve the architect or engineer of his responsibility for his work. The use of such a seal would imply a certain distinction between professional men that does not exist. The courts have held that the architect or engineer is, alone,



PRECAST FLOORS ON STEEL FRAME

This picture was taken during the erection of precast floors on the Shoreland Towers, Indianapolis, one of three luxury apartments designed by Paul I. Cripe, Inc., and built by L and L Building Corporation. All three used Flexicore on a steel frame. This method can cut a month or two off construction time on a job of this size, and give your client a month or two additional rental income. Construction costs are cut by saving weeks of on-the-job labor and the usual delays of poured floors. The smooth underside of the Flexicore floors were exposed throughout, eliminating plaster ceilings. For more information, phone or write your nearest manufacturer listed below, or The Flexicore Co., Inc., Dayton 1, Ohio.

Flexicore slabs are exposed to make attractive ceiling treatment for auto entrance, left, rental unit, center, lobby, right.

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W. R. Bonsal Company, Inc.

OHIO, Akron-Cleveland
Lake Erie Flex., Kent, Ohio

OHIO, Columbus 22
Arrowcrete Corporation

OHIO, Dayton 1, PO 825
Price Brothers Company

PENNSYLVANIA, Monongahela
Pittsburgh Flexicore Company

RHODE ISLAND, Saylesville
Durastone Flexicore Corporation

TEXAS, Houston, 4511 Kyle St.
Flexicore of Texas, Inc.

WEST VIRGINIA, Wheeling
Universal Concrete Pipe Div.

WISCONSIN, Beloit, PO 325
Mid-States Concrete Products Co.

CANADA—Richvale, Ontario
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responsible for his work and the work performed by his associates or employees.

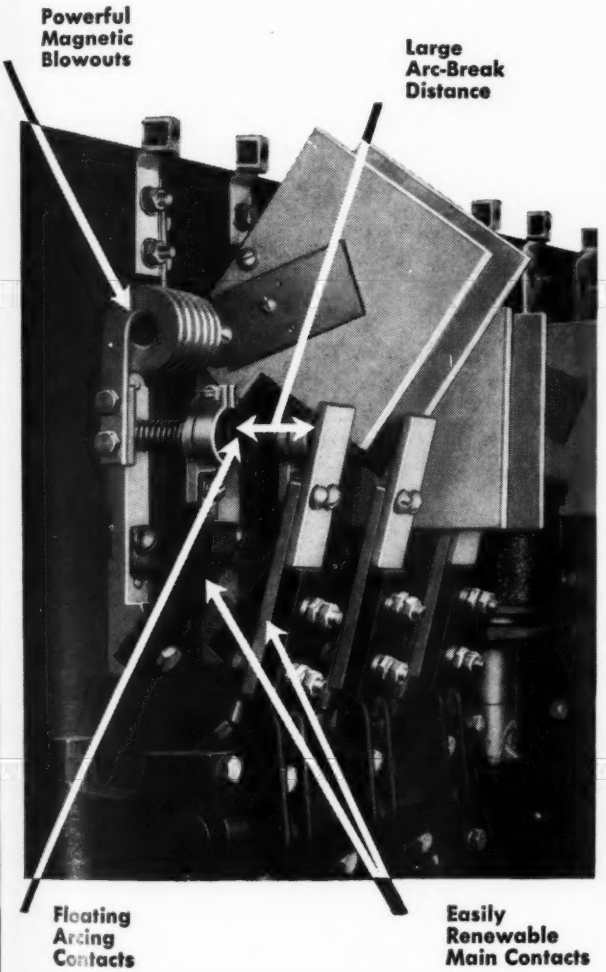
Attorney C. P. Von Herzen, secretary of the Professional Coordinating Council of Los Angeles, representing all professions including lawyers, doctors, and accountants, as well as engineers, appeared in opposition to the use of the union label. His reason for appearing was in the interest of maintaining the status of the professional individual. He expressed the view that labor's interest would be best served by not requiring the professional man to distinguish or to place upon his work any stamp of approval or disapproval that may be implied by the lack of it. He felt he would be embarrassed if he were required to indicate on contracts he had drawn that he was a member of the Los Angeles Bar Association or American Bar Association. He felt it would be impertinent on his part to do so.

C. M. Gould, attorney representing Mr. White, executive secretary of the California Council of Civil Engineers and Land Surveyors, speaking in opposition, pointed out that the union, as such, has no part in the preparation of engineering plans, nor can it claim any responsibility because the preparation of civil engineering plans is restricted by law to registered civil engineers or subordinate employees working under their direction. He further pointed out that the California Civil and Professional Engineers Act, in article 5, section 8761, provides that it is unlawful for any person to sign, stamp, or seal any map, plat, report, description, or other documents unless he is authorized to practice land surveying; and further the Act provides, in section 8731, "that a registered civil engineer and a civil engineer exempt from registration under Chapter 7, Division III of this code, are exempt from licensing under this Chapter, and may engage in this practice of land surveying with the same rights and

NUMBER 1 OF A SERIES

11 reasons why ASCO means adequate Automatic Transfer Switches

ASCO Automatic Transfer Switches are:



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"ASCO Engineered" Automatic Transfer Switch With Circuit Breaker Construction. One Arc Chute Removed.

1. Specifically designed for use in the secondary feeder circuit. Accordingly, these switches incorporate features not required in devices such as motor starters designed for branch circuits. These features are listed below.
2. Designed to withstand inrush currents twenty times normal full load rating. This is especially important for incandescent lamp loads.
3. Rated for continuous 24 hour duty for all classes of load.
4. Capable of rapid transfer – 2 to 5 cycles on small units and 5 to 9 cycles on large. Quick interruption helps prevent flash-over.
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7. Mechanically locked in either position by powerful linkages – no delicate hooks or latches are used.
8. Inherently double throw. No "Off" position possible.
9. Quiet in operation and simple to inspect and maintain.
10. Operated from the source to which the load is to be transferred.
11. Supplied, when specified, with: Full relay protection – to provide for transfer when voltage falls below a fixed percentage of normal; Lockout Relays – to prevent transfer until voltage and frequency are normal; Signal Contacts – used with light or bell to provide an alarm when normal fails; Built-in Time Delay – to avoid operation on momentary power dips and outages.

May we suggest you retain this advertisement in your files? Subsequent issues will continue this factual approach to the subject of Adequate Transfer Switches.

Write for Publication 596 describing how to select Automatic Transfer Switches

Automatic Switch Co.

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ASCO

privileges, and the same duties and responsibilities of a licensed land surveyor." Mr. Gould said that the same reasoning applicable to the California legislative approach are considerations that are also applicable to the Board of Public Works as far as underlying policies are involved. Mr. Gould called the union stamp a traveling picket line and traveling boycott, and said that it is against public policy for government, be it municipal, state, or federal, to become involved in the labor movement or to participate directly or indirectly in labor matters.

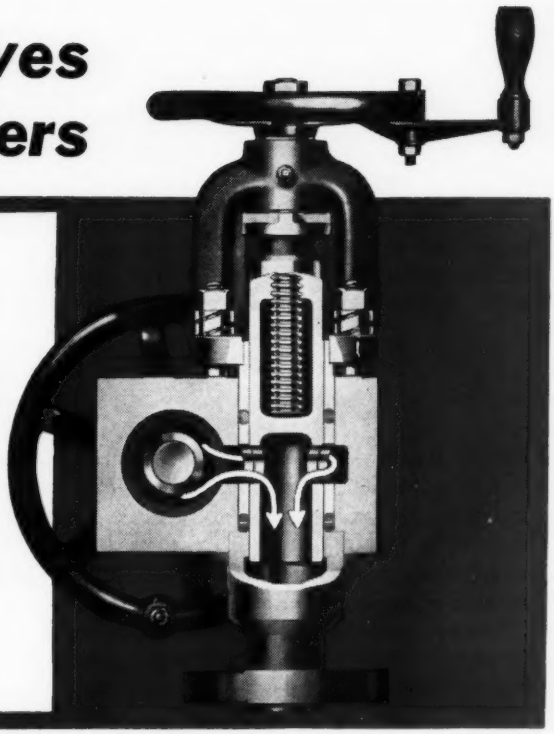
Among the letters addressed to the Board hearing was one from Richard R. Kennedy, an engineer of San Francisco, who said he had discussed this problem with Sherman P. Duckel, the Director of Public Works of the City of San Francisco. Mr. Duckel was very emphatic that no label or seals were placed on city drawings, and that he personally would not consider that it would be proper for any to be placed on drawings submitted to the city. Mr Duckel advised that he was one of the organizers and president for two years of Local 11 of the American Federation of Technical Engineers and had resigned upon taking over his present position with the City of San Francisco.

Admiral Cushing Phillips presided at the hearing as president of the Board of Public Works, with Commissioners Leo M. Strobel, Edward J. Cox, Arch L. Field, and Edward A. Hawkins.

On May 29, the Board of Public Works of the City of Los Angeles adopted a resolution stating that in view of the facts brought out at the hearing, "it was recommended that the Board direct that no engineering or architectural drawing, plan, or document be approved which bears any data, material, or insignia not directly pertinent to the construction of the project for which the plans were prepared, and to the identification and professional status of the persons responsible for their preparation as required by state law." ▲▲

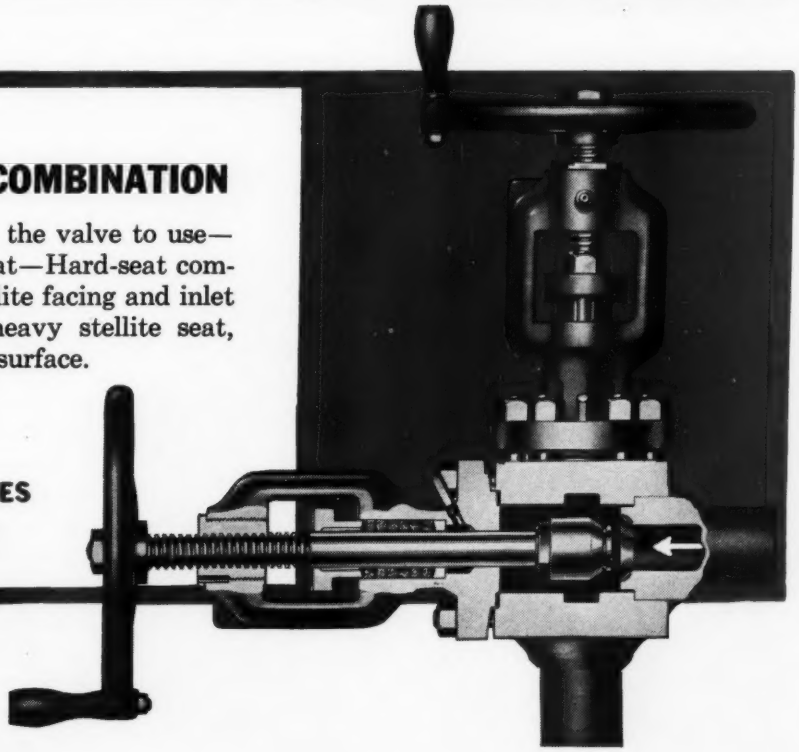
UNIT TANDEM

rugged blow-off valves for high pressure boilers



HARD-SEAT—SEATLESS COMBINATION

■ For boilers up to 1500 psi, this Yarway Unit Tandem Blow-Off Valve offers the maximum in dependable service. A one-piece forged steel block serves as the common body for the Yarway Stellite Hard-seat blowing valve and the Yarway Seatless sealing valve. All interconnecting flanges, bolts and gaskets are eliminated. The Unit Tandem at right is sectioned through Seatless Valve to show balanced sliding plunger in open position and free flow.



HARD-SEAT—HARD-SEAT COMBINATION

■ For boilers to 2500 psi, this is the valve to use—Yarway's Unit Tandem Hard-seat—Hard-seat combination. Disc has welded-in stellite facing and inlet nozzle has integral welded-in heavy stellite seat, providing smooth, hard-wearing surface.

OVER 4 OUT OF 5
HIGH PRESSURE PLANTS
USE YARWAY BLOW-OFF VALVES

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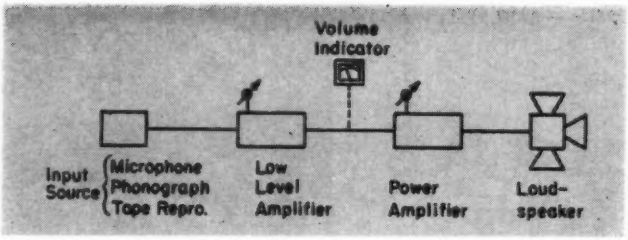
YARWAY **BLOW-OFF VALVES**



BASIC COMPONENTS OF A SINGLE CHANNEL SYSTEM INCLUDE AN INPUT SOURCE, A LOW LEVEL AMPLIFIER, A VOLUME INDICATOR, A POWER AMPLIFIER, AND THE LOUDSPEAKERS.

The Design and Specification of

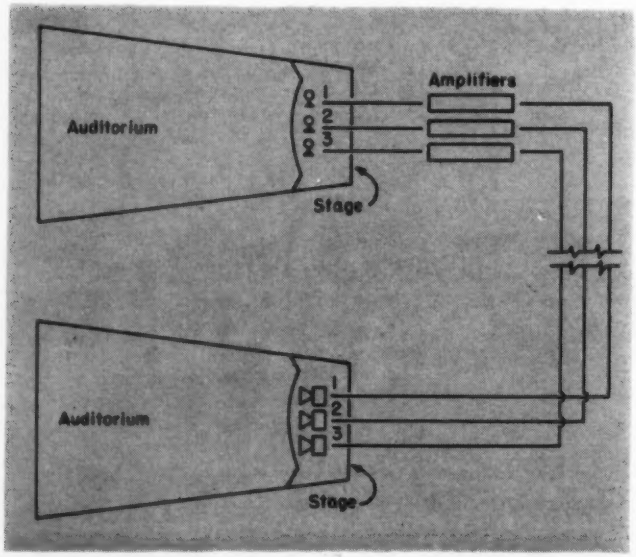
Electronic Sound Systems

HAROLD BURRIS-MEYER

Harold Burris-Meyer is a Washington, D. C. consultant who was formerly professor and director of research in sound at Stevens Institute of Technology. He is a Commander in the U. S. Naval Reserve, and was formerly a vice president and director of MUZAK. He has written a number of books, including "Scenery for the Theatre" and "Theatres and Auditoriums," with Edward C. Cole, and "Acoustics for the Architect," with Lewis S. Goodfriend. He directed, for the Bell Telephone Laboratories, stereophonic recordings for this technique's first public demonstration. He made the first definitive studies of music in industry, the first use of music on railroads, the first use of auditory stimuli for psychological screening, and the first complete control of sound in the theatre. Mr. Burris-Meyer is a Fellow of the Acoustical Society of America and a Fellow of the Audio Engineering Society.

LEWIS S. GOODFRIEND

Lewis S. Goodfriend received his ME degree from Stevens Institute of Technology and his MEE degree from the Polytechnic Institute of Brooklyn. He is currently in private practice as an acoustical engineer in Scarsdale, N. Y. Prior to entering private practice he was engaged in engineering work with several firms including Audio Instrument Co., Audio Facilities Corp., and Rangertone, Inc. He worked with Harold Burris-Meyer on consulting problems involving acoustics and psycho-acoustics, and in the preparation of several books having to do with sound and the application of sound equipment. Mr. Goodfriend was at one time educational advisor for the Audio Engineering Society and editor of the "Journal of the Audio Engineering Society." He is a Fellow member of that organization, a senior member of IRE, and a member of the Acoustical Society of America and the American Institute of Physics.



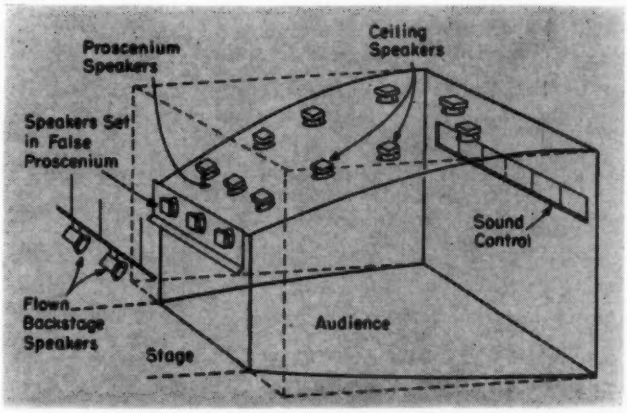
SKETCH SHOWS THE ARRANGEMENT OF STEREOPHONIC TRANSMISSION FROM ONE AUDITORIUM TO ANOTHER.

ELECTRONIC SOUND SYSTEMS should be thought of as basically additive. They make possible the transmission of sound to larger audiences and over greater distances, but they should never be used as a substitute for good acoustical design. Proper acoustical design is the basic requirement, and the structure should be designed as if no electronic system were contemplated. On the other hand, the best structural design cannot, alone, make possible the transmission of sound at an equal level throughout a large auditorium or theater. Unamplified original sound could hardly be heard beyond the twenty-fifth row of the Radio City Music Hall, but electronic sound reinforcement manages to preserve the illusion of the original throughout the entire structure.

In the theater that is too large for the human voice to be understood or to be dramatically effective at the far seats, an electronic system is essential to insure uniform sound distribution. Electronic

control of sound is also necessary in any theater in which the dramatic potentialities inherent in sound are to be exploited to their artistic limits. When Ariel plays his tabour and pipe above the audience, or the magic flute plays, or the sound of the 12-cycle drum beat in Emperor Jones envelopes the audience, or the voice of Brunhilde continues to dominate the orchestra throughout the immolation scene, sound must be subject to spatial, spectral, intensity and reverberation control impossible by mechanical means.

The arena, armory, auditorium, ball park, circus tent, field house, gymnasium, race track, stadium, and terminal all require sound reinforcement for speech or music and sometimes for recorded music. The factory and the office have paging and music systems. The church and auditorium need hearing aids. The restaurant and funeral parlor use music distribution systems, and a costly piece of furniture standing in the corner is no guarantee of good music.



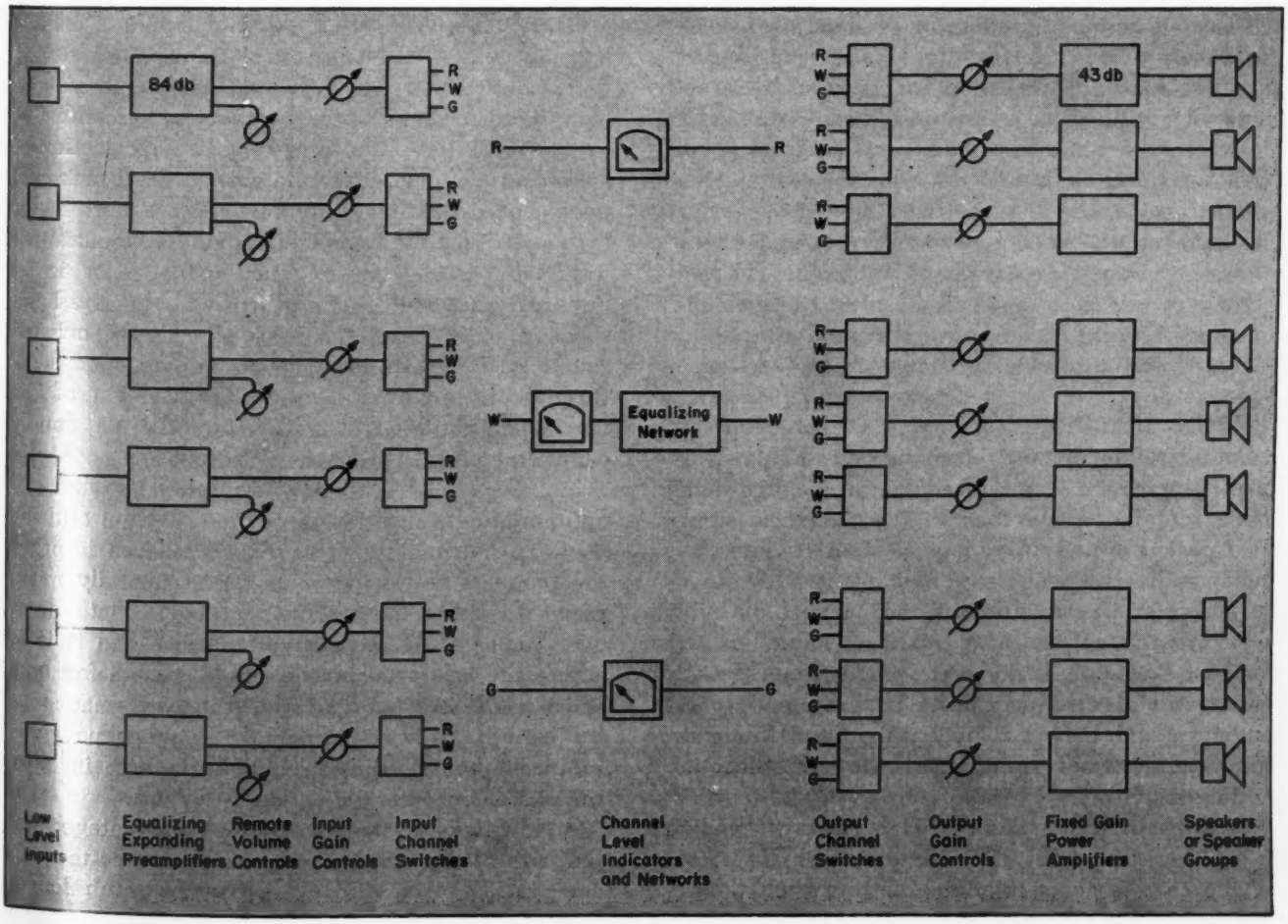
"Theatres and Auditoriums," Harold Burris-Meyer & Edward C. Cole

SPEAKER MOUNTING POSITIONS NECESSARY FOR AUDITORY PERSPECTIVE ABOUT THE HOUSE. PERMANENT PROSCENIUM SPEAKERS OR FALSE PROSCENIUM SPEAKERS FOR STEREOPHONIC REINFORCEMENT. SPEAKERS HUNG UPSTAGE FOR PROJECTION THROUGH PROSCENIUM ARCH.

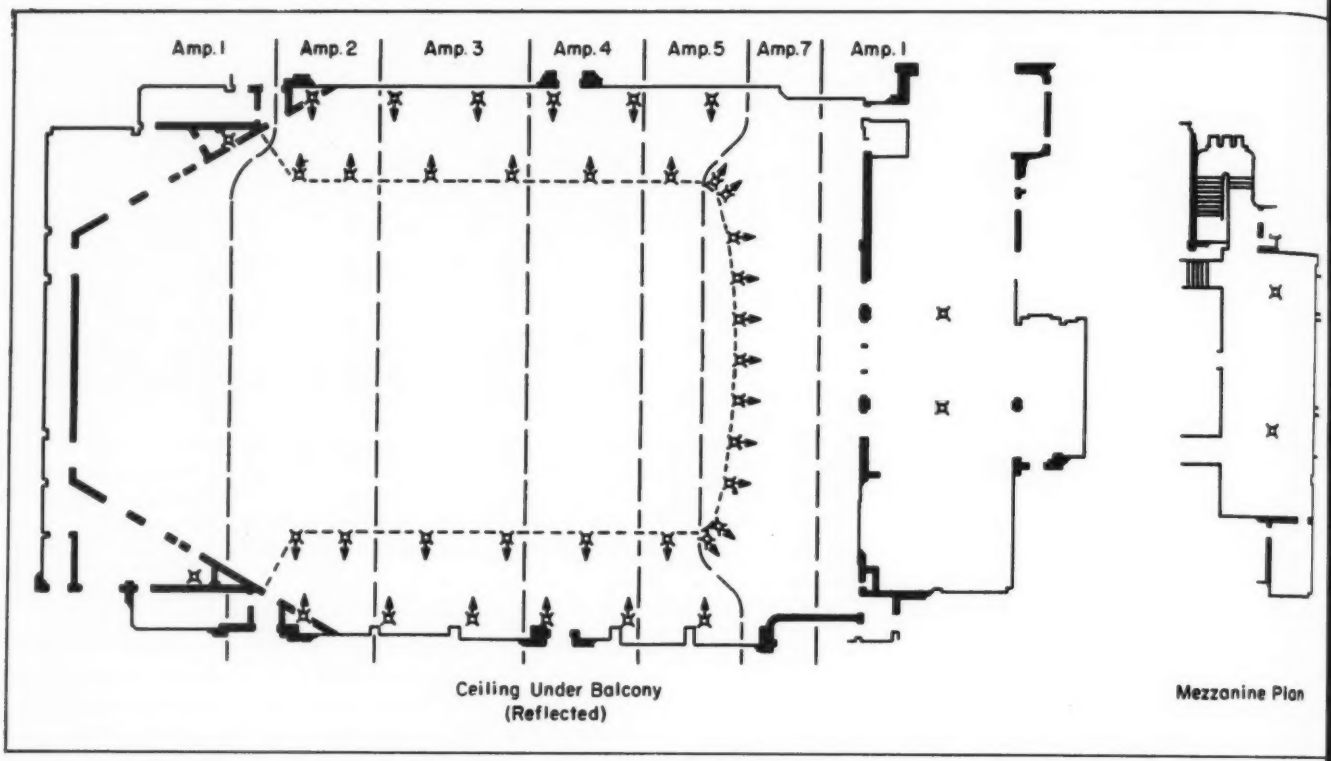
Systems

The simplest electronic sound system is a single channel consisting of one or more inputs (microphone or record), an amplifier, and one or more loudspeakers. The standard hearing aid falls in this classification. Single channel systems generally are adequate for reinforcement of a single speaker or instrument, but difficulties are encountered if the source is diverse, such as an orchestra or a production in which the performers move about the stage.

This single channel deficiency is overcome by a



STEVENS SOUND CONTROL SYSTEM, DESIGNED BY V. MALLORY, MODIFIED FOR MODULAR CONSTRUCTION BY GOODFRIEND.



LOW-LEVEL SYSTEM AT UNIV. OF CONNECTICUT. ARROWS INDICATE DIRECTION IN WHICH SPEAKERS PROJECT TO ACHIEVE

stereophonic system in which three or more inputs are located across the stage or orchestra pit, each associated with a separate channel consisting of amplifier and loudspeaker, these speakers being located above the proscenium or at the forward edge of the apron. Since the sound comes from loudspeakers above or below the source at intensities proportional to the distance from the source to the microphone, the illusion is preserved that sound is coming from the source unamplified. The ear is not very sensitive to elevation, so the fact that the loudspeakers are higher or lower than the sound source is not noticeable.

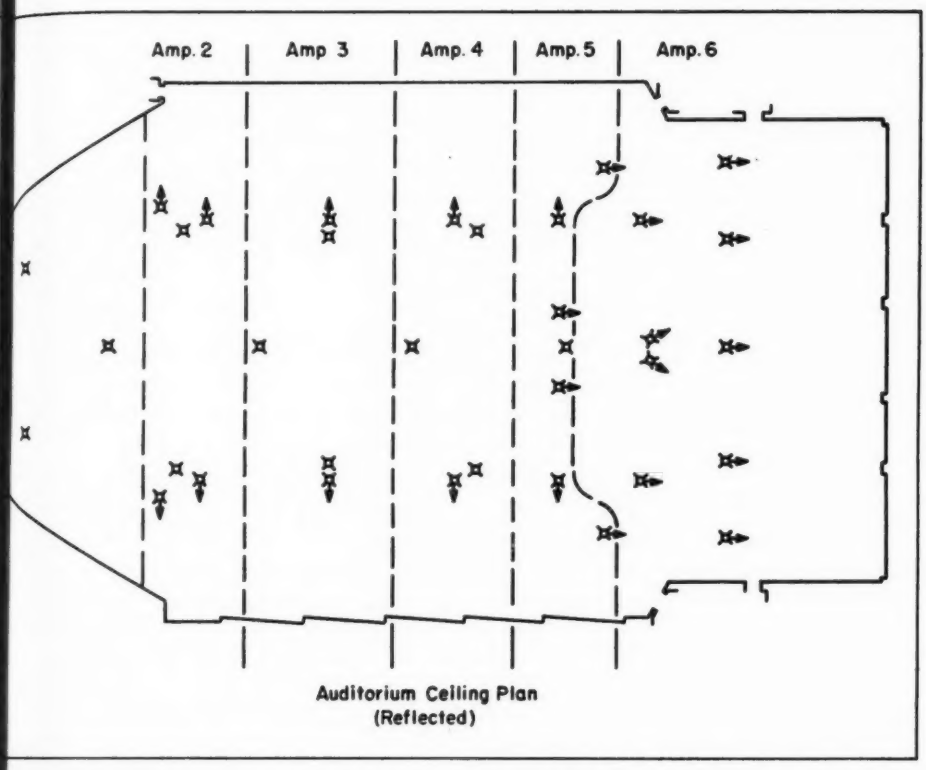
High-Level and Low-Level Systems

Sound reinforcement which involves actual raising of the level of reproduced sound is called high-level sound reinforcement. It employs a single loudspeaker or a group of loudspeakers covering the whole audience area. A good example of a high-level system is a boxing arena where a nest of loudspeakers, above the ring, carries sound to the farthest spectator. High-level systems have the advantage of a uniform distance between source and audience and between loudspeaker and audience. The sound comes from about the same location as the source.

A low-level system is necessary where a ceiling is too low to permit effective projection of sound to the rear of the audience area, or when the reverberant characteristic of the structure — a church, for example — is such that a high-level system would produce reverberant bedlam. It is necessary also when, as with a race track or stadium, a high-level system would constitute a noise nuisance in the neighborhood. The low-level system consists of many loudspeakers located so that every member of the audience is in the direct path of projection of at least one loudspeaker, and where the distance between loudspeaker and audience is so short that a low level of reinforcement provides adequate intelligibility. The level of each loudspeaker is individually adjusted so that the level from the loudspeakers increases as the level of the original sound decreases to provide an equal sound level throughout the area. Despite the location of the loudspeakers, the illusion of direction of source can be maintained if the level is kept low.

In rooms where the reverberation is short of optimum, careful tailoring of the spectrum and the use of a multiplicity of sources often can improve the sound qualities. However, it is generally much easier to apply hard plaster in appropriate areas over some of the absorptive surfaces than it is to adjust the spectrum of the sound system for both artist and size of audience at each performance. In the heavily padded night club, so much power is required that all illusion that the source is other than an electric device is completely lost.

A low-level system has the disadvantage that the path of the original sound from source to audience is for most of the audience much longer than the distance from loudspeaker to audience. This condition can result in decreasing intelligibility as



UNIFORM COVERAGE. F. C. TEICH, ARCHITECT; BURRIS-MEYER, ACOUSTIC CONSULTANT.

the distance of the auditor from the sound source increases, so long as the original sound can be heard at all, because original and reproduced sounds reach the auditor out of phase.

Where original and reproduced sound are both easily heard, it may be necessary to introduce an electronic delay which prevents the reproduced sound from reaching areas remote from the source until the original sound traveling through air gets there. Loudspeakers must be grouped in rows at right angles to the center line of the theater to facilitate the use of delay circuits and to provide progressive increase in intensity as distance from the source increases.

Except in a very small hall, provide on-stage loudspeaker outlets for an acoustic envelope which enables the performer to hear himself.

Control

The complete control of the auditory component of legitimate or operatic production requires a system involving a number of inputs — four to six depending on the size of theater — and eight to twelve channels consisting of power amplifiers and associated loudspeakers. Such a system makes it possible for sound to appear to come from any portion of the theater or stage and gives the illusion of no source or of a moving source by direct projection or by reflection from ceiling, walls, or floor.

Since the uses to which theaters and auditoriums are put usually change several times during the life of the structure, it is wise to make architectural provision for complete electronic control. This costs no more than its omission, and equipment can be installed when needed. While the sound level needs to be raised only a little by electronic means to provide understandability for speech, spatial sound control and enhancement of music take considerable power.

Under optimum conditions, the control room is located at the back of the balcony and is open-faced so that the operator can hear the show as the audience does. It contains voltage and power amplifiers and control console. It is located adjacent to the motion picture booth. A portable control console is desirable in installations where the operator cannot hear from the control room as the audience does. The control room also needs quiet ventilation.

Inferior electronic equipment can spoil good acoustics. If it does not have sufficient power, or is noisy or has a restricted spectrum, it cannot preserve the illusion for the auditor that he is hearing only the original sound, and good architectural acoustical design is wasted. Where only speech is to be reproduced, especially over long distances and in open air, it is possible to restrict the spectrum somewhat in the interest of intelligibility. The more restricted the spectrum, the more efficient the equipment. For indoor or amphitheater installations, however, it is dangerous to restrict the sound system to speech only. It is essential to install a system which will reproduce adequately anything in the audible range and restrict the spectrum, if it is ever desirable, by circuit rather than by shortcomings inherent in the equipment.

Electronic equipment is very sensitive to voltage drop. To keep the system working, the 110-120-volt circuit going to the control room must have nothing else on it.

Microphone cables should not parallel ac mains, which are a source of possible interference, as are also generators or any other large electrical devices.

The specifications on pages 74 and 75 are condensed from those drawn for the sound reinforcing system in the auditorium of the University of Connecticut. Together with the plans shown above and the block schematic diagram on page 75, they illustrate a major low-level installation. ▲▲

Condensed Specifications of University of Connecticut Low-Level Sound System

1. Scope

1.1 The supplier will furnish and install a low-level sound reinforcing system as set forth here and in the accompanying block schematic, and located as indicated on the accompanying plan.

2. Operating Characteristics

2.1 The purpose of the system is to project speech and music from the stage or microphone position on auditorium floor at substantially uniform intensity throughout the auditorium and other areas indicated on the plan.
2.2 All elements shall be controlled from the rack location.
2.3 The system shall be susceptible of being turned on and off, and of control of level from remote panel at the Stage Manager's position.
2.4 It shall be susceptible of control of level from a portable control box.
2.5 Power and voltage amplifiers are to be so interconnected that in case of failure of any unit, rapid replacement may be made by switch or patching.

3. Performance Characteristics

3.1 The frequency response of the complete system shall be substantially flat from 70 to 13,000 cycles per second.

4. System

The system shall consist of:
4.1 Microphones: to have flat frequency characteristic from 30 cycles to at least 10,000 cycles and a useful response to 16,000 cycles.

Adjustable for directional pick-up.

Frequency response must be substantially unchanged when used for distant pick-up and for close talking.

To operate as a 30- to 50-ohm impedance source.

Cable attached to microphone not to be over 6 feet in length and to be provided with suitable connector.
4.2 Suitable shock- and vibration-insulated mountings shall be provided for microphones:

(a) for mounting in footlights.

(b) for suspension over the stage or house.

(c) for adjustable stands for use with singers or speakers.
4.3 Turntable to operate at 33-1/3 and 78 rpm and to accommodate 16-in. discs.

Pick-up and equalizing network to reproduce both laterally or vertically cut discs by switching.

To have 50- or 60-ohm impedance.
4.4 Magnetic Tape Recorder-Reproducer and Associated Equalizing Amplifier: To record and reproduce from ¼-in. full track magnetic tape at 7½ inches per second.

Equalizing amplifier to be susceptible of remote volume control.

To operate as a 600-ohm impedance source.
4.5 Cable: All signal cable to be two-conductor #20, approximately 0.268 inches in outside diameter, color coded, inclosed in a woven metal shield, and covered with a layer of good rubber.

Portable microphone cable to be made up in 25-ft lengths.

Speaker lines to consist of #18 or heavier rubber covered, twisted pairs.
4.6 Connectors: Microphone signal line connectors connecting portable microphones to permanently installed signal lines and portable microphone cables.

NAB standard microphone connectors.

Permanent connectors to be located on and above the stage and in auditorium floor and above ceiling as shown on plan.
4.7 Racks: Inclosed, ventilated.

To accommodate standard 19-in. panels.
4.8 Preliminary Amplifiers: To have 30- to 50-ohm input and output impedance and a minimum gain of 40 db.

Each of these units to be equipped with an individual gain control.

Four preliminary amplifiers to be connected to each voltage amplifier.
4.9 Voltage Amplifiers: To be complete, self-contained and each to include its own power supply if possible.

To be provided with a 3-position switch so arranged that the gain of each voltage amplifier can be controlled: (a) at the rack, (b) at Stage Manager's position, (c) from a portable control box which can be plugged into either of two positions shown on plan.

Volume controls of such design that they may be operated without frequency discrimination or noise pick-up at 200 feet from the amplifier.

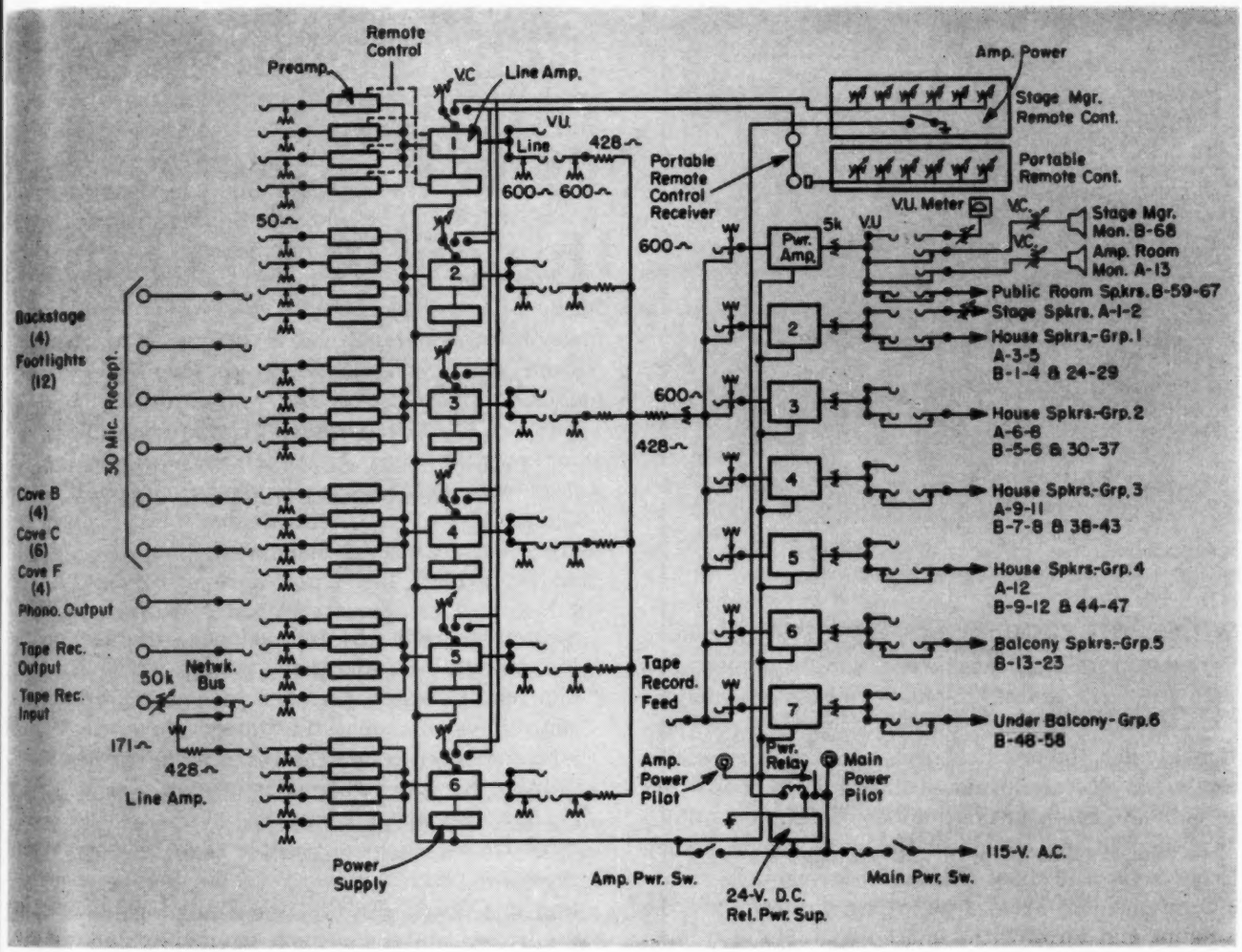
Undistorted output level to be at least 18 dbm with maximum output noise level of —40 db below 1 milliwatt. Frequency response ± 1 db in range 35 to 15,000 cycles per second. Gain, 50 db.

To operated as a 600-ohm impedance source.

Voltage amplifiers to contain frequency discriminator networks.
4.10 Remote control panel to be provided at Stage Manager's position, to contain on-off remote contactor to control system power supply and volume controls for all voltage amplifiers as specified in paragraph 4.9.
4.11 Portable remote control panel mounted in suitable housing and provided with suitable cable and two shielded pairs with suitable attaching plug.

Two permanent connectors at points shown on plan to connect with 3-position switch (paragraph 4.9).
4.12 Provision shall be made for switching output of each voltage amplifier into a common channel so that the impedance reflected to other amplifiers shall not change appreciably.
4.13 Power Amplifier: To be self-contained with its own power supply.

To have a gain of at least 45 db from bridging input across 600 ohms at + 4 dbm.



BLOCK SCHEMATIC DIAGRAM OF UNIV. OF CONNECTICUT LOW-LEVEL SOUND SYSTEM, DESIGNED BY F. W. NICKERSON.

Frequency characteristics: Response to be within 5 db from 35 to 15,000 cycles.

Output power to be 50 watts with less than 5 percent total harmonic distortion or 25 watts with less than 1 percent harmonic distortion.

To have bridging input of at least 25,000 ohms.

4.14 Speakers: Type A to have frequency response of 70 to 13,000 cycles.

At least 8 watts power handling capacity.

Speaker type B to have frequency response similar to Type A and at least 4 watts power handling capacity.

To be individually adjustable in volume for three levels and off.

To be located as shown on plans.

To be connected to power amplifiers as follows as a standard hook-up.

Amplifier 1: Speakers on stage, Stage Manager's monitor, sound system amplifier room monitor, front house.

Amplifier 2: All house speakers, stage to end of splay.

Amplifier 3: House from splay to face of rear balcony.

Amplifier 4: Group nearest stage.

Amplifier 5: Rear balcony.

Amplifier 6: Under rear balcony.

Amplifier 7: Public rooms and spare.

This arrangement to be susceptible of easy variation to conform to operating requirements.

Monitor to be controlled by individual volume control.

4.15 Baffles: Speakers to be inclosed in infinite baffles of at least 2-cu ft capacity made of ¾-in. plywood lined with Kimsul.

5. Power

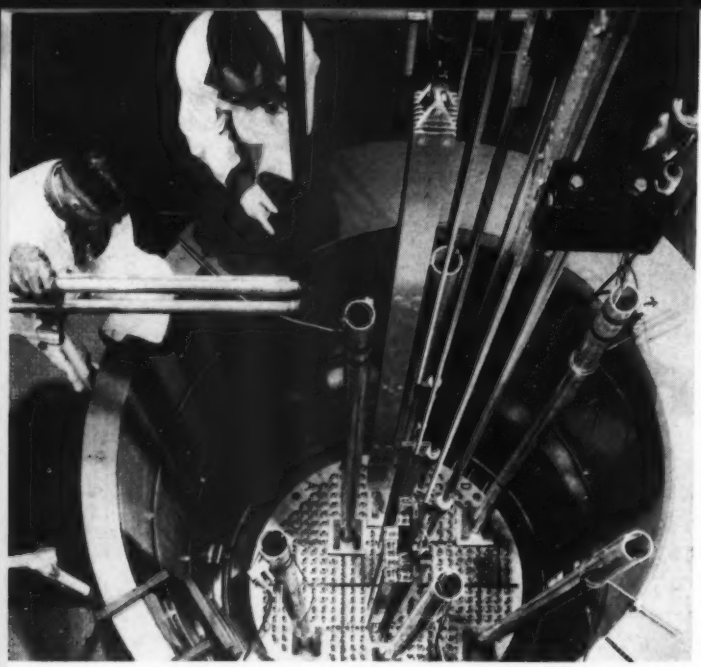
5.1 A 60-amp line, 60 cycle, 117 volt, ac at rack location.

6. Installation

6.1 Signal Lines: To be run in conduit from microphone connector location shown on plan to rack location.

6.2 Conduits carrying signal lines not to run parallel to ac lines wherever possible.

6.3 Remote control lines to run from rack position as follows: Twisted pairs: #18 for on-off relay. Seven-wire #18 and two shielded pairs for remote volume controls.



Babcock & Wilcox

The Economics of Nuclear Power Plant Design & Operation

CORBIN ALLARDICE
Atomic Energy Advisor, International Bank For Reconstruction and Development

WHILE THE GENERAL CONCEPT of producing nuclear power is simple, involving as it does the use of a reactor simply as a heat source in lieu of a conventional boiler, the practical design of a specific reactor system involves enormous difficulty. A choice has to be made between the number of design possibilities open to the engineer. He must decide among three fuels, and must determine from nuclear considerations and from operating economics the amount and form of the chosen fuel. He also must determine what fertile material he will employ since, except in special purpose reactors, it is necessary to convert some nonfuel material (fertile material) into fuel material in order to produce economic nuclear power. He must choose the neutron energy range in which the reactor will operate, since nuclear characteristics of the fuel, the fertile material, and all other materials in the reactor vary with neutron energy and thus effect the performance and economics of the power plant.

He must choose a suitable coolant to remove the heat. His system may be heterogeneous, with pieces of fuel embedded in a moderator or otherwise fixed in discrete positions; the system may be homogeneous, in which the fuel is a slurry or solution. If his reactor system operates in the slow or intermediate neutron range, he must select a suitable moderating material (moderator) to slow down the fast neutrons released in each fission event. Reflectors, control systems, operating temperature ranges, and a host of other design choices must be made.

Table 1 suggests the wide range of possible design choices. Perhaps as many as 100 of the 900 possible combinations may be feasible. The reactor systems presently under advanced development or construction in Canada, France, the United Kingdom, and the United States represent the more obvious design choices. Each system has been shown to be workable, but no system has yet been operated as a full-scale commercial power producer. The more promising systems now under advanced development or construction are described briefly in Table 2. The gas-cooled reactor system has taken priority in development in France and the United Kingdom. This is due to several factors, the most important being the scarcity of heavy water, the scarcity or unavailability of enriched uranium or plutonium, the greater relative experience with air-cooled or gas-cooled systems, and the inherent safety of those systems. In the United States, on the other hand, there is no serious scarcity of any material, and the systems under development are more diverse. In Canada, the emphasis is on natural ura-

TABLE 1* — CHOICES TO BE MADE IN REACTOR DESIGN

Fuel	*Fertile Material*	*Neutron Energy*	*Coolant*	*Geometry*	*Moderator*
U233	Thorium	Fast	Gas	Heterogeneous	Normal Water
U235	Uranium	Resonance	Liquid Metal	Homogeneous	Heavy Water
Pu239		Slow	Normal Water		Beryllium
			Hydro Carbons		Beryllium Oxide
			Heavy Water, etc.		Carbon, etc.

*From P/862 by A. M. Weinberg; Proceedings of the International Conference on Peaceful Uses of Atomic Energy, Vol. [illegible] P. 24.

nium, of which Canada has a plentiful supply. Thus, it can be seen that purely technical considerations are not necessarily the influencing factors in choice of reactor systems for early development and construction in any country. Indeed, the U.S. program shows that each of the systems (with the exception of gas-cooled, graphite moderated thermal reactors) has its strong adherents in the U.S.

In sum, several different technical systems for producing nuclear power are already in an advanced stage of development or construction. Each system has been shown to be feasible, although precise economic information will not become available until full-scale power reactors have been operated.

However, their design and manufacture require a highly skilled technology available only in the more maturely industrialized nations. Thus, particularly in underdeveloped countries, the acquisition of nuclear power plants will involve not only foreign exchange, but also access to technical information, technical assistance, and probably the execution of intergovernmental agreements between the supplier nation and the purchaser nation.

Cost of Nuclear Power Facilities

The actual cost of building and operating an atomic power plant will, of course, determine whether electricity from that plant is competitive with electricity from other sources. It is clear that the capital cost of a nuclear power plant today is higher than the capital cost of an equivalent thermal power plant. The estimated costs of nuclear power plants now being considered for commercial development range between $230 and $320 per kilowatt of capacity. This compares with about $120 to $160 per kilowatt for conventional thermal plants. On the other hand, it is expected that the fuel component of power cost for a nuclear power plant should be lower than that for fossil fuels in most places, and, unlike other fuels, that cost would be relatively the same for the same reactor system no matter where the plant is located. Assuming other operating and maintenance costs not associated with fuel are about the same, the savings on fuel over the life of the plant will represent the total amount available to cover the presently higher capital cost and faster depreciation of the atomic power plant.

Table 3 lists nine nuclear power reactors now under construction or in advanced design stage. No cost information is available on gas-cooled French power reactors, but it can be assumed that their costs would be no less than those for the U.K. gas-cooled reactors. The U.K. AEA gas-cooled reactor was the first central station power reactor to come into operation. It is a dual-purpose plant, in that it is so designed as to permit the simultaneous production of power and of military grade plutonium having a low percentage of the Pu-240 isotope. Its successors, however, the gas-cooled U.K. CEA plants, will be designed with major emphasis on the production of power.

The first large U.S. power reactor is the pressurized water reactor being built for the U.S. AEC by Westinghouse. This reactor is an outgrowth of U.S. experience in designing and building the propulsion reactor for the USS Nautilus, and the

Table 2—Reactor Systems

Aqueous Homogeneous Reactors — in which a dilute solution of a salt of slightly enriched uranium 235, uranium 233, or plutonium in heavy water is utilized as the fuel. In the "two region" design this solution is circulated through a tank surrounded by a larger vessel containing the blanket material, a solution or slurry of fertile material, thorium or uranium, which utilizes the neutrons escaping the core, to produce new fissionable material. A "single region" homogeneous reactor system, which would have no fertile blanket, is also proposed. (U.S.)

Boiling Water Reactors — in which heat from the core is transferred by allowing the cooling water (either normal or heavy) to boil within the vessel containing the fuel elements. If normal uranium fuel is used the coolant-moderator is heavy water. (U.S.)

Fast Breeder Reactors — in which an unmoderated core fueled with plutonium or U235, and cooled, for example, with sodium is used. The core is surrounded by a uranium blanket to utilize the neutrons which escape the core. (U.K. and U.S.)

Gas-Cooled Graphite Reactors — in which normal uranium or uranium enriched with U235, U233, or plutonium in the form of rods or slugs is contained in a graphite moderator. Carbon dioxide under pressure (or other suitable gas) is circulated through the reactor to remove the heat. (France and U.K.)

Liquid Metal Fuel Reactors — in which a liquid fuel composed of a few hundred parts per million of uranium 235 or uranium 233 in molten bismuth circulates through a graphite moderator. The heat is removed from the liquid metal solution and used to generate steam. A liquid blanket of uranium — or thorium — bismuth slurry surrounds the reactor, and utilizes neutrons from the core to make fissionable material. (U.S. and U.K.)

Organic Moderated Reactors — in which slightly enriched fuel is used and the coolant-moderator is a suitable organic liquid such as terphenyl or diphenyl. The system does not have to be highly pressurized to prevent "boiling," and the organic liquid, which has good moderating properties, is also essentially noncorrosive. (U.S.)

Pressurized Water Reactors — in which water (or heavy water) under high pressure to keep it from boiling is circulated through a vessel or tubes containing solid fuel elements of slightly enriched or, in the case of heavy water, natural uranium. The water is then passed through a boiler to produce steam to drive a turbo-generator. (Canada, U.S. and U.K.)

Sodium Graphite Reactors — in which advantage is taken of the high temperatures and high efficiencies to be gained through the use of sodium as the coolant. The moderator is graphite and slightly enriched fuel is used. (U.S. and U.K.)

Water-Cooled Graphite Reactors — in which natural or slightly enriched uranium is used as fuel. The moderator is graphite and the coolant is light water. The system is pressurized to avoid boiling. (U.S.)

TABLE 3 — EARLY NUCLEAR POWER PLANTS IN CANADA; U. K.; AND U. S.

Builder	Reactor Type	Electrical Capacity, Mw	Estimated Capital Cost, $ per kw	Estimated Completion Date
U. K. Atomic Energy Authority	Gas-Cooled	> 70	~ 625	In Operation
U. S. Atomic Energy Commission	Pressurized Water	> 60	~ 630	Fall 1957
Consumers Public Power Dist.	Sodium Graphite	75	320	1962
Atomic Energy of Canada Ltd.	Pressurized Heavy Water	20	600	1959
Yankee Atomic Elec. Co.	Pressurized Water	134	230	1960
Power Reactor Dev. Co.	Fast Breeder	100	540	1960
Nuclear Power Group	Boiling Water	180	250	1960
Consolidated Edison	Pressurized Water	236	233	1960
U. K. Central Electricity Authority	Gas-Cooled	> 250	~ 320	1960-1961

system has been shown to be satisfactorily operable under the severe conditions encountered in forced submerged operation.

Estimates given for the Yankee and ConEd reactors are based upon extensive technical experience gained in building the Nautilus and PWR reactors. It is not known whether they may contain subsidies from the manufacturers, since they were both contracted for after spirited competition among the leading electrical equipment and boiler manufacturers. The ConEd nuclear reactor, for example, is budgeted at $55 million. Babcock & Wilcox has bid to build the nuclear steam generating portion for a fixed sum which represents about one-third of the budget total. The rest is for site improvement, turbines, generators, and other standard equipment.

The Consumers Public Power District sodium-cooled graphite reactor is based on extensive sodium handling technology derived from North American Aviation's sodium reactor experiment, the AEC's experimental breeder reactor, and its submarine intermediate reactor, all of which use liquid sodium or sodium-potassium alloy as coolants. The Nuclear Power Group boiling water reactor also is based on considerable U.S. AEC experience. The General Electric Co. has bid to build the entire reactor and power generating equipment for $45 million. The other U.S. reactor system listed in Table 3 is the fast breeder reactor, and represents the greatest extension of present technology, which is evident in the higher estimated cost per kilowatt. However, this reactor could have essentially zero, and possibly negative, net fuel costs.

The Canadian Nuclear Power Demonstration (NPD) pressurized heavy water reactor is more in the nature of an experimental than power reactor although it will have a significant electrical output. It has been estimated that second generation pressurized heavy water reactors of this design will cost about $250 per kilowatt and will have capacities in excess of 100 Mw electric.

On Fig. 1 are plotted the dollars per kilowatt costs of these nine reactors in relation to their capacity in megawatts. The reactors plotted as solid dots are those of an advanced type which involve a substantial extention of present technology and those that are the first or prototype reactors. Plotted as open dots are the reactors based on substantially developed technology or upon which firm bids have been obtained from manufacturers. For this latter class, which can be taken to represent the early commercial reactors, the dollars per kilowatt costs range between $230 and $320. As the size of the plants approaches about 100 Mw, the cost per kilowatt tends to level off at about $230 per kilowatt.

The Estimated Cost of Nuclear Power

Assuming a capital cost of $250 per kilowatt for a 100-Mw nuclear power plant, it is then necessary to establish estimates of costs for operating and maintenance, fuel, depreciation, and return on investment. There is no firm experience upon which to base estimates of operating and maintenance costs per kwh produced, but most studies on the economics of nuclear power reactors indicate that such costs should be close to those for normal thermal stations. It is to be expected that for the first year or two of operation of early nuclear power plants, operating and maintenance costs may be higher, perhaps double those for standard plants; the basic simplicity of operation of a reactor, however, would seem to permit these costs in later years to be about the same as for conventional plants. In any event, this component of cost of electricity is not very large — for large central station plants in the United States it adds about 0.5 to 1.0 mill per kwh.

The average of the estimated costs reported in 16 studies of the economics of nuclear power at Geneva for the combined operating and maintenance cost for a large nuclear power station is 2.02 mills per kwh. This value is between 2 and 4 times the cost derived from U.S. experience with large conventional thermal stations and probably higher than actually will be experienced.

Insurance costs for a nuclear plant undoubtedly will be higher than for a conventional thermal plant. However, the cost of insurance for a conventional plant is such a small percentage of the total operating costs that even a substantial increase in insurance cost would not materially affect the total

cost of power generated. Solution of the insurance problem undoubtedly will vary in different countries. It is expected that the cost of insurance will represent a small portion of the cost of power. If 2 mills per kwh operation and maintenance cost were assumed, this would be sufficiently liberal to cover the cost of insurance.

Fuel Costs

A key factor in achieving economically competitive nuclear power is the cost of the nuclear fuel, including fabrication, value of new fissionable material made, reprocessing, and inventory charges. This cost is dependent upon the type of reactor, the amount of fissionable material — both originally charged and newly made — that is utilized effectively for power production, the particular fuel reprocessing cycle, the uses to which by-product fissionable materials can be put, and the total inventory of fuel (i.e. fuel awaiting loading, fuel in the reactor, and fuel in reprocessing plants). The economic feasibility of nuclear power is directly related to the success with which efforts to minimize the fuel component of cost is met.

While it is possible today to make reasonable and probably conservative estimates as to the cost properly chargeable to fuel, the economic feasibility and relative attractiveness of different reactor systems will be demonstrated only as actual operating experience is gained, not only with the reactor but also with ancillary metallurgical and chemical facilities. Intergovernmental agreements as to fuel prices, fabrication and reprocessing of fuels, and inventory charges will have a major bearing on the feasibility of competitive nuclear power.

At present all supplies of nuclear fuels are government-controlled and costs of production have not been released. The United States, however, has established a scale of prices at which it will sell or lease fissionable and source materials, and at which it will buy back plutonium and uranium 233. It also has established charges for chemical processing of spent fuel elements. The fuel cost, which will be assumed in this article, is derived from calculations not inconsistent with the U.S. schedules.

The fuel costs of any reactor will depend upon a large number of variables and must, of course, be calculated individually for each particular reactor system. Basically, in a reactor some atoms of a fissionable material are fissioned or otherwise destroyed, some are left in the fuel elements, and some new atoms of fissionable material are formed. There are involved, in computing the fuel component of power cost, certain metallurgical, fabrication, reprocessing, and waste disposal costs in addition to the values of the fissionable material destroyed or made. Since fissionable material in the reactor fuel cycle represents a large amount of immobilized capital, inventory charges are made against the fissionable material held in the fuel cycle.

Fuel and inventory costs for 16 reactors (not all thermal, natural uranium systems) were estimated

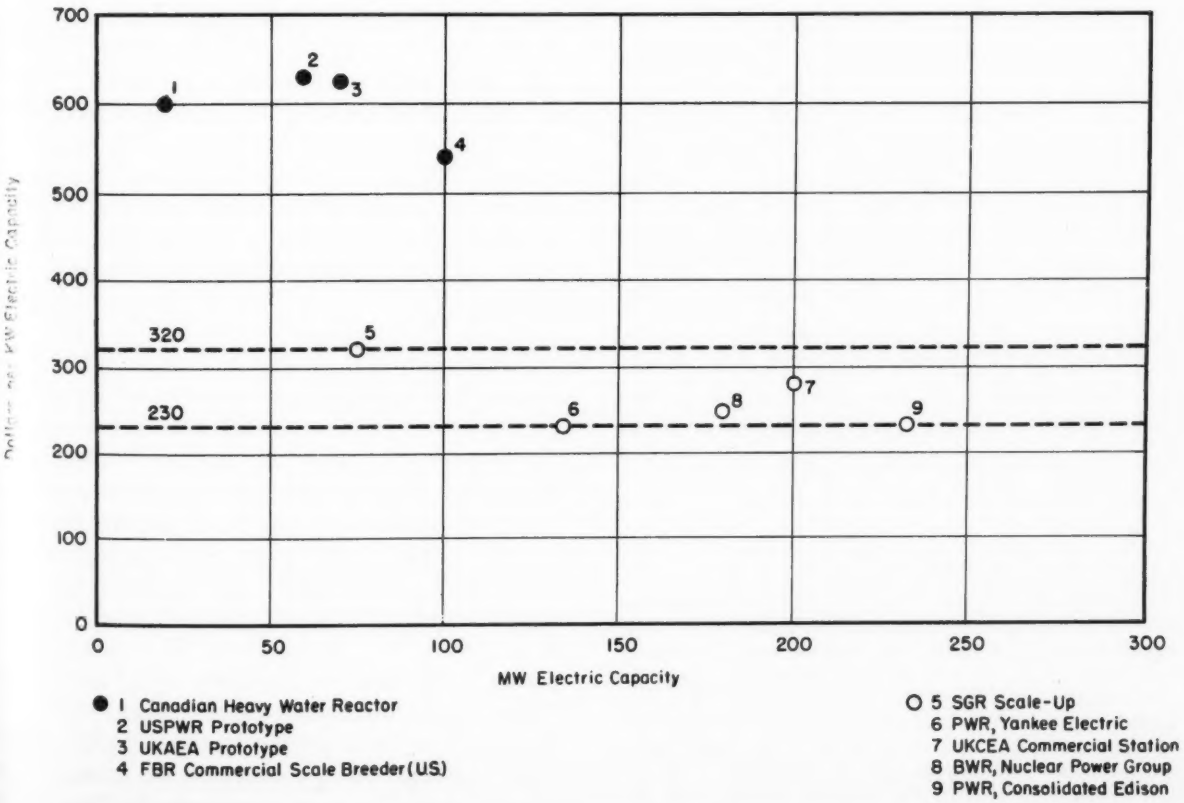


FIG. 1—ESTIMATED COSTS OF NINE POWER REACTORS IN RELATION TO MW ELECTRIC CAPACITY.

TABLE 4 — COST OF GENERATING NUCLEAR POWER*
Expressed in U.S. mills per kwh

	Plant Factor				
	50%	60%	70%	80%	90%
Nuclear Fuel	2.5	2.5	2.5	2.5	2.5
Operation and Maintenance	2.0	2.0	2.0	2.0	2.0
Depreciation	2.3	1.9	1.6	1.4	1.3
Generating Cost*	6.8	6.4	6.1	5.9	5.8

*Excluding return on investment.

in various Geneva papers. The average of these costs is about 2.85 mills per kwh. The spread of such fuel costs, depending upon the value assigned to plutonium either as a by-product or as replacement fuel, the irradiation level to which the uranium fuel elements may be subjected, and the fuel cycling chosen, depend upon the reactor system employed. For breeder reactors the fuel costs could become zero, and even may show as a credit. For thermal reactors in which irradiations of 8-10,000 MWD per ton can be achieved, the fuel and inventory cost can be perhaps as low as 0.5 mill per kwh. These latter systems are, however, not achievable with present technology; they may be expected in third or later generation plants.

For the purpose of this analysis the fuel and inventory cost for an early commercial nuclear power reactor, comprising a reactor system, such as presently under design or construction, will be assumed to average about 2.5 mills per kwh over the 25-year life of the plant. Since this is an assumed value, for any specific reactor system a specific fuel and inventory cost must be calculated using the specific parameters of the specific system. Included in this assumed value above is approximately 0.9 mill per kwh to cover inventory charges on the immobilized capital represented by the fissionable and fertile material committed to the nuclear power reactor, including not only all the nuclear material in the reactor, but also that being fabricated into fuel elements, being stored for cooling after irradiation, and being chemically processed. The amount of material so committed will depend upon the specific reactor.* The allowance of 0.9 mill per kwh, which has been included in the assumed fuel and inventory charge of 2.50 mills per kwh, in a 100-Mw plant operated at a 50 percent plant factor, would provide income of about $395,000 per year to cover financial charges on fuel inventory.

Amount and Pattern of Use

Since the capital costs for a nuclear power station are higher than for a comparable thermal station, the amounts charged in the selling price to cover return on that capital investment and depreciation are larger than would be required in a thermal plant. In order to bring those charges within reasonable limits, it is necessary to spread them over as large a number of units of production — kilowatt-hours — as possible. This indicates the need to operate nuclear power plants at as high a plant factor as possible, or, in other words, as base load stations.

Since we also have seen that the capital investment per kilowatt probably would be sharply higher for plants of less than about 100-Mw capacity, we must be sure that the system into which the nuclear plant is to be integrated is capable of accepting a 100-Mw plant as a base load installation with a high plant factor.

A study conducted by the General Electric Co. of modern conventional thermal power stations in the United States revealed that over the life of these plants a plant factor of 43 percent was achieved. The G.E. study suggests that nuclear stations, because of lower fuel costs, should achieve a lifetime plant factor of 50 percent. On the other hand, the U.K. Central Electricity Authority believes early nuclear plants will operate with a lifetime plant factor of 75 percent. Because the fuel and operating component of cost of the nuclear plant will be lower than such costs in a thermal plant, it is reasonable to expect that the nuclear plant, in competition with thermal plants, will be operated in later years of its life at a much higher rate than would a thermal plant of equivalent age.

Depreciation

For a conventional thermal plant, plant life will be taken as 33⅓ years, and the depreciation rate will be 3 percent of the capital cost per annum on a straight-line basis. For the nuclear plant, about 30 or 40 percent of the capital cost is represented by conventional equipment which would have the same life as in a conventional plant — 33⅓ years. The remaining 60 to 70 percent of the capital cost comprises nonstandard, specialized items for which a plant life of 20 years will be assumed. The early large size nuclear reactors at Hanford, Washington which began operation about 12 years ago, still are performing satisfactorily as is the smaller air-cooled reactor at Oak Ridge, which began operation somewhat earlier. The combined over-all plant life of the nuclear plant therefore will be taken as 25 years,

* According to Mr. W. K. Davis, Director of the U.S. Atomic Energy Commission's Division of Reactor Development, the total value of the inventory of nuclear fuel may be as high as $50 per electrical kilowatt for some reactors, and in typical heterogeneous reactors the value will be in the range of $20 to $40 per kilowatt. In homogeneous reactors the value may be appreciably less. Accepting the higher value, i.e. $50 per kilowatt, a 100-Mw reactor might require something like $5 million worth of nuclear fuel in inventory. P/477 — "Capital Investment Required for Nuclear Energy," by W. K. Davis, *Proceedings International Conference on Peaceful Uses of Atomic Energy.*

and the plant will be depreciated at 4 percent of its capital cost per annum on a straight-line basis. The use of a 4-percent, straight-line depreciation schedule is considered acceptably prudent from a banking point of view.

The question of obsolescence of a nuclear power plant should be mentioned at this point. In a conventional thermal plant the primary reason for obsolescence is that new plants display a consistently higher thermal efficiency and consistently lower operating costs, and since the cost of operations and fuel are together the most significant part of the selling price of electric power at the bus bar in conventional thermal plants, the new plants are able to make power cheaper than old ones. It is to be expected that later nuclear plants undoubtedly will be able to produce electricity at lower fuel costs than the earlier plants. However, the older plant will also benefit from advancing technology and, in some cases, will be able to show comparable decreases in fuel costs in later loadings, as new alloys or new methods of fabrication enable a larger burnup of the fissionable material in the core. As was pointed out earlier, the fuel component of cost of electricity generated in a nuclear power station can be expected to be significantly less than the fuel component of cost of electricity generated in a conventional thermal station except in low-cost fuel areas. Thus, from the operating and fuel cost point of view, the problem of obsolescence of a nuclear power plant is more comparable to that of a hydroelectric station than to a conventional thermal station.

Generating Costs for Nuclear Power

Table 4 contains calculations of the cost of generating nuclear power (including depreciation) in a 100-Mw nuclear plant costing $250 per killowatt of electric capacity operated at various plant factors. This table does not, however, include a return on investment, and in view of the larger capital investment required for a nuclear power plant as compared with a conventional thermal station, this burden of financial charges is of major importance in evaluating where and under what circumstances nuclear power may be economically attractive.

Comparative Costs

We are now in a position to compare the cost of electricity generated in a nuclear plant with the cost of electricity generated in a conventional thermal station. The conventional thermal station has lower operating and maintenance costs — about 0.8 mill per kwh on the average in the U.K. and U.S. in contrast with the 2.0 mills per kwh cost for the nuclear plant. Since the capital investment for a conventional thermal station has been taken as $120 per kilowatt as compared with the $250 per kilowatt for the nuclear plant, and since depreciation has been set at a more rapid rate for the nuclear

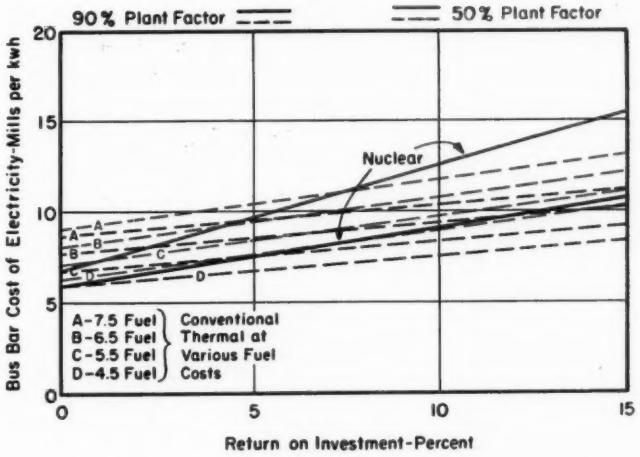


FIG. 2—COMPARATIVE COSTS OF ELECTRICITY FOR 100-MW CAPACITY PLANTS—NUCLEAR VS CONVENTIONAL THERMAL AT VARIOUS FOSSIL FUEL COSTS.

plant (4 percent per annum, straight-line, as contrasted with 3 percent per annum, straight-line, for the conventional thermal station), depreciation and financial charges also will be higher for the nuclear plant than for the conventional thermal station. On the other hand, the fuel component of cost of electricity generated in a nuclear power plant should be considerably less than the cost of fuel used in a conventional thermal station, except in low-cost fossil fuel areas.

The relative attractiveness of the nuclear plant when compared with the conventional thermal station is largely dependent upon the cost of fuel for the conventional station and upon the rate of financial charges appropriate in the specific location. Fig. 2 compares the cost of electricity generated in a nuclear power plant of 100-Mw electric capacity built on essentially today's technology, with the cost of electricity generated in a conventional thermal station of similar capacity, at various fuel costs for a conventional plant.

Numerical Examples

At a 50-percent plant factor, where fossil fuel cost is 4.5 mills per kwh or less (equivalent to $11.70 per short ton for 13,000 Btu per pound coal burned in a plant having a 34-percent efficiency), a conventional thermal station is more economical than a nuclear station, irrespective of what rate of return is attributed to the investment in the plant. On the other hand, if the fossil fuel cost is 7.5 mills per kwh ($19.50 per short ton for 13,000 Btu per pound coal burned in a plant having a 34-percent thermal efficiency), a nuclear plant could afford to pay up to 7½-percent return (after depreciation) on the investment and still produce electricity more economically than a conventional thermal plant.

At a 90-percent plant factor, a nuclear station again could not compete with 4.5 mills per kwh fossil fuel. It could compete with 5.5 mills per kwh

fuel ($14.25 per short ton for 13,000 Btu per pound coal burned at a thermal efficiency of 34 percent), at a 6½-percent return or less. If cost of fuel were 6.5 mills per kwh ($16.90 per short ton for 13,000 Btu per pound coal burned in a plant having a 34-percent thermal efficiency), a nuclear plant could afford up to 12½ percent on investment and still be more economical.

Heat Reactors

The considerations that have been discussed relative to power reactors apply to the process or space heat reactors. The capital cost of a process heat reactor probably would be less — perhaps as much as 20 or 30 percent less — than for an electric power reactor, since the turbo-generator side of the plant would be essentially eliminated. On the other hand, the problem of finding a suitable system or plan to utilize the large amount of heat produced is limiting.

The effect of size on process heat reactor costs would be similar to that noted for the nuclear power reactors, and there will be a size below which the process heat reactor will steeply rise in cost per unit output. Just what that range of size will be is yet to be determined. In sum, as concerns process or space heat reactors, no calculations or analyses of their economics have been published; thus, while that application is of interest it appears premature to attempt to arrive at judgments as to its economic feasibility.

It should be noted that Sweden is planning an experimental space heating reactor of about 90-Mw thermal capacity to be completed around 1960. This reactor is planned to provide space heating to portions of the City of Vasteras (population about 65,000). Norway also is considering an experimental industrial heat reactor for use in conjunction with a wood processing plant at Halden. This reactor would have a thermal capacity of 10-12 Mw and would begin operation in about three years. It is expected to provide about 20-25 percent of the plant's hourly steam requirements. Detailed information on these reactors, and the estimated economics of their operations, should begin to be available for analysis soon.

Small Power Reactors

The development of small nuclear power stations, suitable for use in remote locations such as the Arctic or in underdeveloped countries where the demand for electricity occurs in relatively small units, has not progressed as far as has the development of larger central station units. Work is going on, particularly in the United States and Canada, to develop reactor systems for such smaller, specialized uses.

As a rough estimate, if nuclear power can be produced for 20 to 30 mills per kwh in plants having capacities of 3 to 5 Mw electric, there would be a considerable demand for such reactors in the remote areas of Canada, for example, in some areas of Africa, and undoubtedly in Asia and South America. To make 20-30 mills per kwh nuclear power, the capital cost for the reactor probably would have to be no more than about $600 per kilowatt. This implies a production rather than a custom scale manufacture. As of today, however, it is not possible to evaluate the economic feasibility of building a reactor in the 3-5 Mw range.

For reactors in the 10 to perhaps 30 Mw range, some estimates have been made. There, the capital costs might be about $600 per kilowatt, and the fuel and inventory costs perhaps 9 mills per kwh. The operating and maintenance costs might be about 2 mills per kwh. If a 10-percent return on investment is assumed, and a plant factor of 80 percent, such a plant might produce power which could be sold at the bus bar for under 25 mills per kwh. It is to be expected that the fuel cost and the capital cost will lower as the technology develops. It is reasonable to expect later plants of this size to produce power which could be sold at the bus bar at about 15 mills per kwh at a plant factor of 80 percent and perhaps lower depending upon financial charges.

Three reactors being considered by American and Foreign Power for installation in South America fall in this category. It will be possible to arrive at a somewhat more definitive appraisal of the economic feasibility of reactors in this size range after the bids for the three AFP reactors have been submitted, and the designs made available for analysis. The 10-Mw reactor which Westinghouse is to build for Belgium is also in this size category.

Medium Size Range

In the medium size reactor range (30 to 80 Mw), the problems of development are much like those for the larger central power plants, and their introduction will follow, rather than precede, the commercial entry of the larger plants which are already under development. It is to be expected that the capital cost of such reactors will be higher per kilowatt of capacity than for the larger stations, since the cost of turbo-generator equipment and the cost of the reactor are affected more exponentially than linearly by a decrease in electric capacity.

Fuel costs of such reactors should not be significantly different than for the larger central station nuclear plants. Because the cost of electricity from conventional stations in this size range is usually higher than electricity for larger thermal stations, the nuclear plant undoubtedly will be able to compete in this size range also. However, as of today, it is not possible to develop a detailed analysis of what cost to expect, since little developmental interest has been directed thus far toward such a reactor. The United States is planning to design and construct several reactors of this size range, but no estimates of cost or of performance are as yet available. ▲▲

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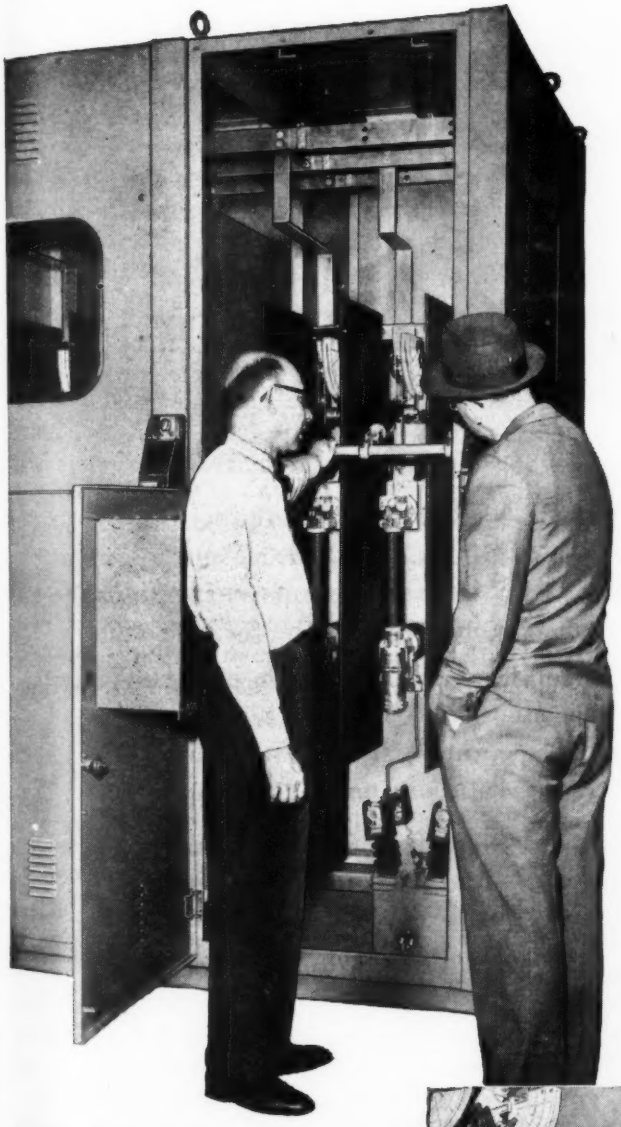

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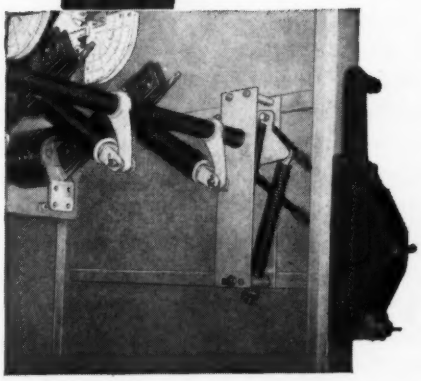

RIGHT—*TOG-L SNAP operating mechanism, featuring "OVR-CENTR" spring actuator—optional, but important to safety in closing*

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How to Write Engineering Specifications

A REPORT FROM THE COMMITTEE OF ONE-HUNDRED. Every building project undertaken by a consulting engineer, whether a new $100-million hydroelectric plant or a $1000 lighting modification for a small school, involves the writing of specifications. These specifications, plus the plans, define what the engineer wants done for his client.

The writing of a good set of specifications is no simple matter. Even consulting engineers disagree among themselves as to what good specifications are. Contractors certainly disagree — among themselves, and with consulting engineers. So far as manufacturers are concerned, the only good specifications are those naming their product.

There are, however, certain areas of agreement, and in an effort to establish these, we questioned *Consulting Engineer's* "Committee of One-Hundred," prominent engineers from all parts of the country, representing all sizes of firms and fields of specialization. This report is a composite of their thinking. It is not the opinion of any one man on the Committee, but all of them will agree with most of it, and most will agree with all.

AN ENGINEERING SPECIFICATION is a contract drawn up by the consulting engineer. It tells the contractor what he is expected to do for the engineer's client. To do this properly, the specifications should:

¶ Define the scope of work to be performed.

¶ Describe the type of material, equipment, and performance required.

¶ Explain the quality of workmanship needed.

¶ List the governing codes, rules, and regulations under which the work is to be performed.

¶ Make clear the guarantees expected of suppliers, contractors, and others.

The specifications, along with the plans, are the visible results of the engineer's studies, investigations, and decisions. They make it possible for the contractor to prepare his estimates of cost of labor, materials, and equipment and tender a bid on the job. They bring together the technical mind of the engineer and the skilled hands of the workman. They should provide the client, within the price range allowed, with the best materials and equipment, put together in a skilled manner.

Contractors and manufacturers should recognize that specifications establish basic standards of performance. These must be considered minimum standards, and they must at least be equalled and should be surpassed when possible.

Engineers should understand that specifications need not tell the contractor how to perform his job but should state what end results are to be achieved. There are exceptions to this, and it is sometimes necessary to outline exactly construction procedures in order to be sure that results are as required, but generally, construction methods should be left to the contractor. His ingenuity may make it possible for him to discover simpler methods that reduce his costs while maintaining quality. It is wrong

to so restrict his operating methods that he cannot make use of good, time-saving ideas. An engineer should limit the contractor's freedom in construction procedure only when the contractor's methods will be to the detriment of the finished project.

The Open Specification

Specifications fall into three general classifications — Open, Restricted, and Closed. Open specifications, sometimes called performance specifications, never name an item of equipment or a material by manufacturer's name. The specifications are "open" for any manufacturer or supplier to tender a bid. This type of specification is general on work for government agencies. Many government agencies are required by law to use open specifications. The intent of these laws is admirable. Failure to observe them would be a wide open invitation to graft, kickbacks, and favoritism. Most government agencies require, therefore, that specifications be open except in those instances in which open specifications are impractical.

While respecting the reasons requiring open specifications for government work, the consulting engineer knows that it is next to impossible to write absolutely open specifications for any but the simplest projects. As one engineer says, the only time a specification is truly open is before it has been written — before the engineer has decided what he wants.

If the engineer describes only the performance required of the equipment, he can go no further with his design until bids are in and equipment is selected, for if he has no idea what space will be required or what fittings the equipment will take, he can hardly be expected to make his layout or draw his plans. And without plans, the contractor cannot turn in a bid. All comes to a standstill. "Neither can move until the other has proceeded."

Therefore, there can be no such thing as a Simonpure open specification. The engineer must describe what he wants in enough detail to permit the contractor to bid, and this means that the type of equipment to be used must be basically established, and automatically some manufacturers or suppliers are eliminated — without a name or a brand having been mentioned.

Materials are more adaptable to open specification than equipment, for concrete, steel, sand, or aluminum can be described as to quality without regard to manufacturer, and many engineers do use open specifications for materials of this type even on work for private clients.

When the client requests open specifications, the engineer should be careful to stay within the spirit of the request. Every engineer knows that the most open-appearing specification actually can be tightly closed. All the engineer needs to do is to specify some small and unimportant characteristic of a particular manufacturer's product, and he can eliminate competition without appearing to have done so. No matter how sure the engineer is that the product he has in mind is best, no matter how much he may be convinced of the advantages of his selection, this practice is unethical. The engineer is the agent of the client, and if the client, for legal or other reasons, demands open specifications, he should get open specifications. If the engineer is unwilling to work under those conditions, if he feels that open specifications are to the detriment of the project, then he should not take the job.

While most consulting engineers dislike the use of open specifications because they do not allow them to hold close control over the selection of specific brands, there are some advantages. When specifications are open, or as open as possible, there is broad competition among manufacturers and suppliers, and this can lead to lower prices under certain conditions. It may cost more to put all the unrelated pieces together into one harmonious whole, but at least the individual items are bid competitively. Then too, open specifications let new firms, or relatively unknown firms, bid directly and competitively against old and well advertised products. They give a good new product an equal chance.

So far as the engineer is concerned, the open specification is more expensive to prepare. The description must be detailed enough to eliminate all improper equipment — yet no names can be mentioned. Then when the contractors list the equipment they are proposing, each item must be tested and studied in great detail to be sure that it meets the performance level demanded. This is time-consuming and costly.

The open specification is further time-consuming in that the contractor may take weeks in shopping for price. Naturally, this delays construction. Also, the manufacturer is usually more anxious to meet delivery dates if he is making a reasonable profit than he is if he has had to whittle his price.

Restricted Specifications

Restricted specifications, sometimes called bidder's choice specifications, are those in which the material or equipment is described and then pinned down by limiting the contractor's choice to one of two or more brands, the particular quality or models usually being described by catalog number. With this type of specification, it is customary for the engineer to add to the description the phrase "or approved equal." In theory this permits the contractor to use other than the brands named if the engineer approves the choice. In practice the engineer writing the specifications usually has in mind those brands he will accept and those he will not — far beyond the actual wording of the specification.

A few years back it was customary to use the phrase "or equal" in these specifications instead

of "or approved equal" as is now used. This is indicative of an important change in the position of the consulting engineer. Today, the engineer is not expected to accept the contractor's statement that a substitute is equal to the material or equipment specified. Instead, the engineer must approve any substitutes. It also is becoming the practice to accept substitutes on contractors' bids only if the substitutes are approved well in advance of the day bids are submitted. This means the contractor not only must get the engineer's approval of substitutions, he must get this approval far enough in advance so that all contractors bidding on the job can know what substitutions are acceptable.

Most engineers feel that this restricted type of specification is best for most work done for private industry. It allows competition among contractor, supplier, and manufacturer, within a limited range, while still permitting the engineer to design with good knowledge of what the final selection will be.

Restricted specifications are particularly adaptable to items such as plumbing, piping, wiring, fixtures, and other items of this type — items that are relatively standard in size and application regardless of brand. Extremely complicated equipment cannot be handled so well with restricted specifications, for just as with the open specification, the engineer must know what is to be selected before he can proceed with detail design or the provision of space for installation.

Contractor's Preference

Most contractors seem to prefer restricted specifications. They know exactly what brands will be accepted, yet the door is open for them to suggest substitutes. Where the open specification puts a great deal of responsibility on the contractor, making him decide what equipment will meet the performance requirements, restricted specifications throw much of this responsibility back on the engineer, where it belongs.

While the restricted specification permits substitutes, the engineer becomes suspicious of the contractors who are "substitute happy." Contractors are always acutely conscious of price and price advantage. While an engineer looks at a set of specifications as a description of minimum standards, all too often the contractor is looking for loopholes that will permit him to make a lower bid than his competitor and still make a profit. Engineers have found that in most instances substitutes suggested by contractors are for the primary purpose of a price advantage and not for some reason having to do with the improvement of the project. While the engineer should examine suggested substitutes without prejudice, he must be careful to see that the contractor is not substituting price for quality.

There is a difference, however, between the engineer having the courage of his convictions and his simply being bullheaded. The engineer does not always know everything about everything, and when a contractor offers a substitute that is actually better than the specified item, the engineer's duty is to accept it without feeling that his prerogatives have been restricted.

Closed Specifications

The closed, or base bid specification, is just what the name implies. The engineer writes one particular brand, usually by catalog number, into the specifications, and that is the end of it. While this sounds as though it eliminates competition. and could cost the client money, that is by no means always so. A careless engineer who hurriedly picked some product from a convenient catalog and then closed his specifications could cost his client money, but that is not the way a closed specification is written — no matter what the eliminated supplier may think.

The difference between an open specification and a closed specification is much a matter of timing. When the design concept of the project is in its early stages, all specifications are open. Those manufacturers' representatives who overlook this fact and wait until the specifications are written before they call on the engineer just must accept it gracefully when they are written out. They will have to set their clocks up and get to the engineer before he makes up his mind on the next project.

Some engineers now are making it a practice to get prices on all principal items of equipment from all reputable manufacturers before they select the combinations they feel are best. Then they write closed specifications that eliminate all but the selected products. This method has many advantages. It provides competition on price while eliminating all opportunity for deals or kickbacks between salesmen and contractors. It means that the selection of the equipment is entirely the responsibility of the consulting engineer — as it should be, for he is acting as the owner's agent.

As one engineer puts it, "The entire problem of specifications must be re-examined and the writing of the specifications changed to agree with correct concepts of the relationships among the engineer, the architect, the general contractor, the specialty contractors, and the subcontractors. The engineer has become, in effect, a purchasing agent for the owner and now should be recognized as such. The specifications should be set up with this concept in mind. Only then can the problem of open and closed specifications be resolved."

From the engineer's point of view the closed specification has advantages. He knows exactly what materials and equipment are going into the project, so he can make detailed drawings and have them ready when the bids are called for. There will be no need for redesigning several sheets of plans because some items of equipment require different

space or different fittings from those first specified. The client gains because he can have better engineering at lower costs.

Contractors look upon closed specifications with mixed emotions. They cannot go out and shop for price — the product already has been selected by catalog number. The cost to every contractor for materials and equipment will be just about equal. Therefore, the only way the contractor can underbid his competitor is by finding ways to reduce labor costs. He must search for ingenious construction and installation methods rather than for deals he can make with suppliers. It is the smart contractor, with good foremen and supervisors, who can make the low bid. The contractor who depends on price shopping and corner cutting does not have a chance. This should work to the client's advantage.

With closed specifications the contractor has the advantage of being relieved of all responsibility for guarantees on materials and equipment. The engineer and the manufacturer or supplier are entirely responsible. The contractor need guarantee only his workmanship — which again is as it should be.

How Firm Should a Specification Be?

A specification should be as firm as the engineer's opinion of his work. If he is unsure of his decisions, he is open to suggestions from anyone. If he knows his subject and is up to date on his information, then his specifications are as firm as his convictions. When the engineer is sure he is right, no one should be in a position to overrule his decisions. It should be clearly written into all specifications that no changes can be made without the engineer's written permission, and if an owner or an architect insists on changes, the responsibility for the success of the project should rest with him, not with the engineer. The engineer has not only a right, but an ethical responsibility, to remove himself from the job when others refuse to abide by his final decisions.

No changes should be permitted in specifications after the construction contract has been let, except in the most unusual instances — when there are errors or omissions, for example. To permit changes in the specifications after the letting of the bid is a serious injustice to those contractors who failed to get the job. They might have got the job had they known of those changes and their effect on construction costs.

What Factors Influence Choice of Products?

Engineers agree that their choice of one brand of material or one particular product over another depend on:

¶ The suitability of the particular piece of equipment or brand of material for the particular installation being designed.
¶ The manufacturer's reputation.
¶ The performance history of similar equipment.
¶ The engineer's opinion of the design, material, and workmanship of the equipment.
¶ The cost in relation to quality.
¶ The promised delivery date and the manufacturer's reputation for meeting that promise.
¶ Availability of engineering data on the product.
¶ Reputation of the local supplier or representative.
¶ Availability and quality of local service facilities.
¶ The manufacturer's reputation for sincerely attempting to comply fully with the specifications.
¶ General acceptance by engineers of the brand name as a symbol of quality.
¶ Reputation for prompt attention to complaints.

These factors are not listed in the order of importance, and the most influential factor in selecting one type of equipment might fall far down the list when another type of equipment is being considered.

How Can Engineers Improve Their Specifications?

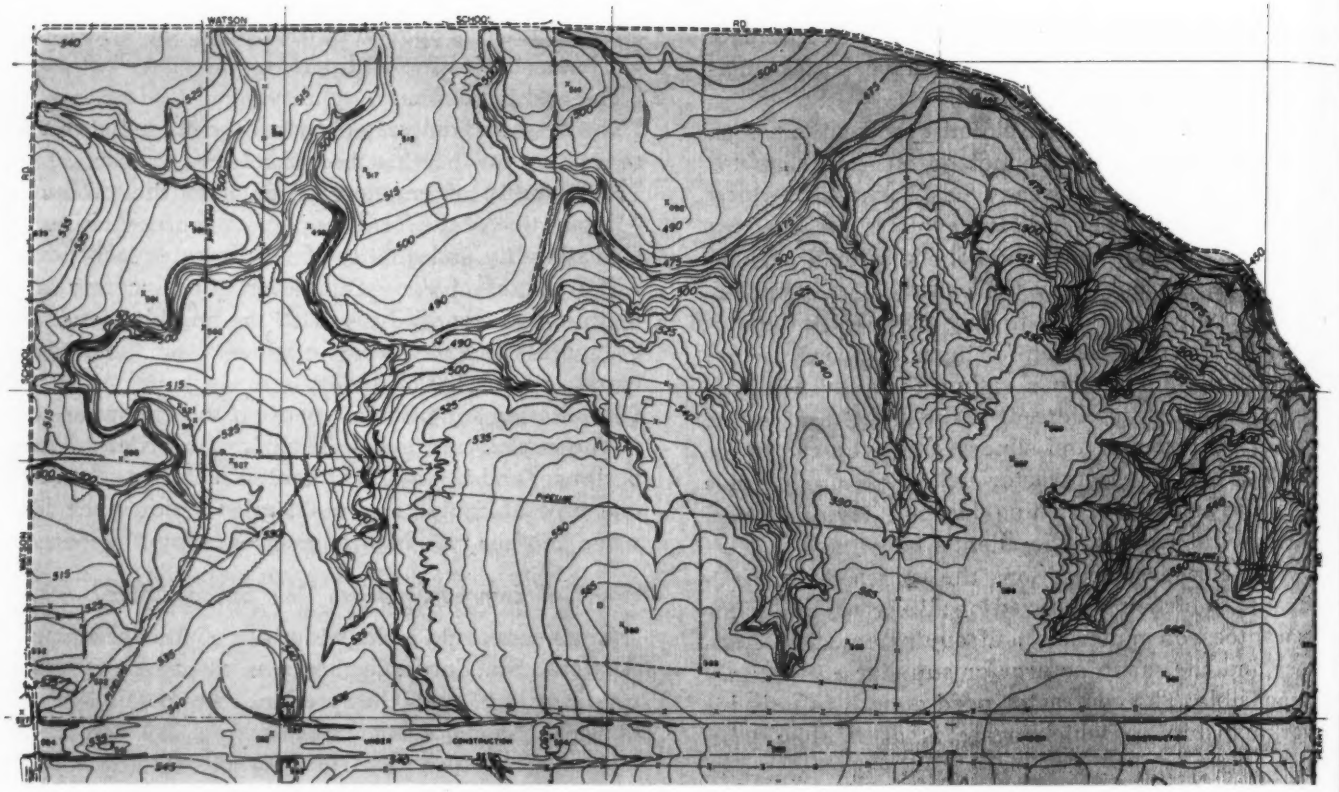
Engineers could make wider use of standard specifications. Standard specifications assure clear, concise wording, and they reduce the possibility of omissions and of misunderstanding by the contractor. They also save time for the engineer. This does not mean that the engineer should simply reproduce an old set of specifications for a new, nearly similar job. It does not mean that he substitutes a standard in place of careful consideration of the special requirements of the project. It does mean that the adoption of a standard specification eliminates excess verbiage and makes possible the preparation of concise, clear, comprehensive, and easily understood documents. The standard specification should be thought of as a form of writing, never as a substitute for careful study of requirements.

A number of reputable organizations such as the American Society for Testing Materials have prepared sets of standards which the engineer can use. They make possible the full description of the desired materials by merely stating the ASTM standards the materials must meet. The American Water Works Association, the American Petroleum Institute, and several of the Founder Societies have codes and standards that can be used to advantage in the writing of simplified specifications.

Naturally, the specifications must match the plans. All too often, a contractor can find a loophole by catching some point on which the plans and the specifications do not agree. He makes use of whichever interpretation is to his advantage.

The engineer also must be sure that his specifications comply with all codes and laws. Not only is this important from a legal point of view but overlooking of regulations gives the contractor a good and necessary reason for making changes.

While a set of specifications is a legal document, it need not be full of legal language. It must be clear, it should be concise, and it ought to tell exactly what the engineer wants for his client. ▲▲



CONTOUR MAP OF AREA NO. 1 OF THE GREAT SOUTHWEST INDUSTRIAL DISTRICT BEFORE WORK STARTED.

Developing a New Industrial Area

RICHARD L. POWELL, Powell & Powell

Richard L. Powell, of the Dallas, Texas firm of Powell & Powell, received his B.S. in Civil Engineering from the Agricultural and Mechanical College of Texas, in 1938. He immediately went to work as a draftsman for the City of Wichita Falls, Texas, a year later changing jobs to become Junior Irrigation Engineer with the Farm Security Administration of the U.S. Department of Agriculture. Shortly before the war, he was made Assistant Traffic Engineer of the City of Dallas, leaving this position to join the U.S. Army Corps of Engineers, in June 1941. He was assigned to troop duty as Company Commander, Regimental Engineering Officer, and Battalion Commander responsible for training and for planning and execution of military engineering operations in the European Theater. Returning to Dallas, in late 1945, he became a member of the firm of Powell & Powell and has served as resident engineer on construction. He is a member of the Society of American Military Engineers and an associate member of the American Society of Civil Engineers.

A PLANNED INDUSTRIAL AREA in any part of the country has a common denominator with all others, though each presents a unique set of problems to its developers and planners. As civil engineers, Powell & Powell, has been associated with a number of industrial developments in the southwest. One of the most interesting has been the Great Southwest Industrial District, 5000 acres in the exact center of the Dallas-Fort Worth metropolitan area, being developed by the Great Southwest Corporation. The northern half of this district — 2300 acres — now is in the active development stage.

This development lies within the municipalities of Arlington and Grand Prairie, two young cities of considerable importance. It is almost bisected in an east-west direction by the Fort Worth-Dallas Turnpike, scheduled for completion this summer,

and it is adjacent to the central toll plaza used for access to the Turnpike. The property is bounded on the south by transcontinental U.S. Highway 80 which leads to Dallas or to Fort Worth, with connections to highways radiating to every part of the country.

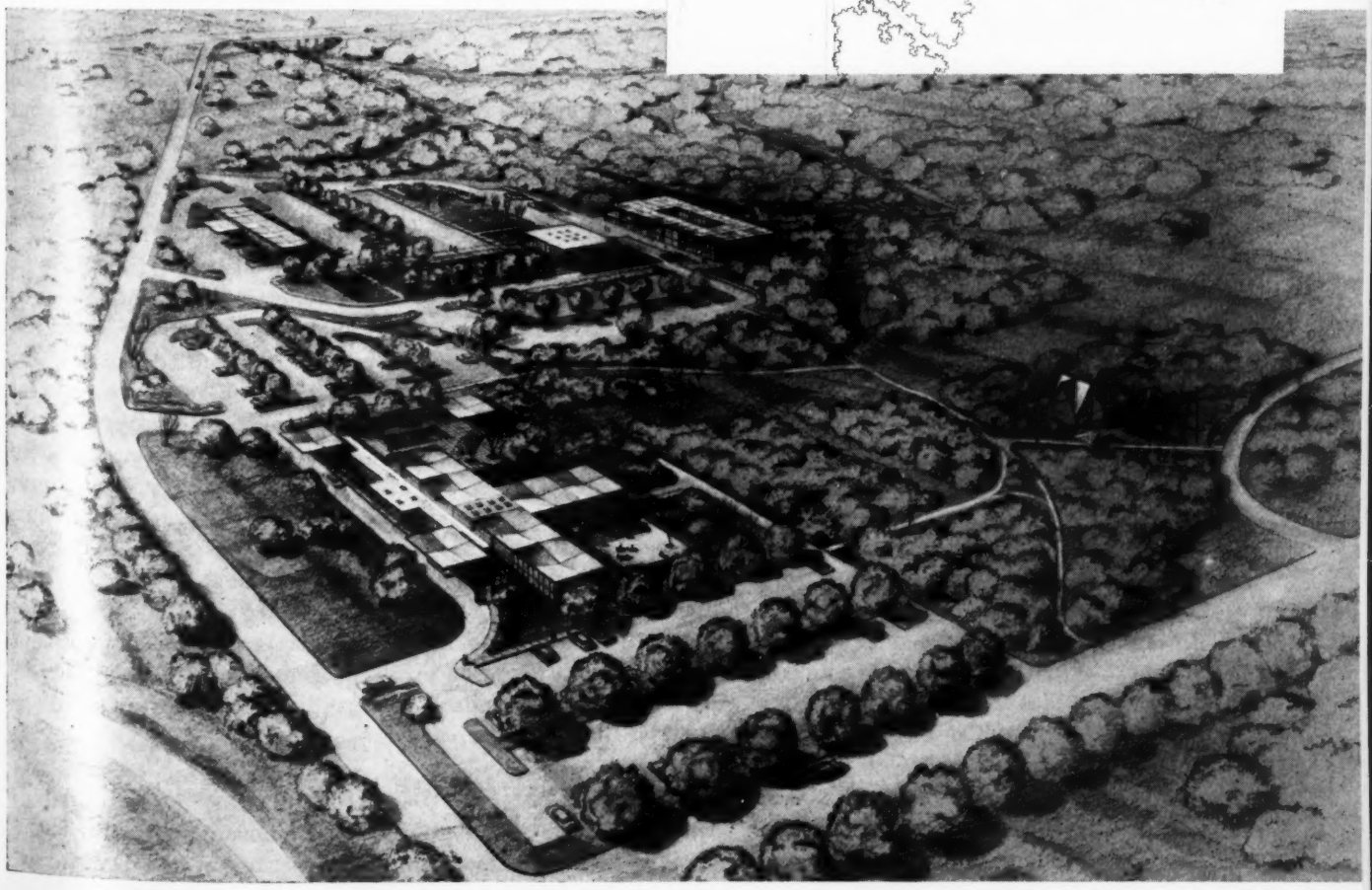
Again, it will be divided in a north-south direction by State Highway 360, planned as an expressway for eventual connection to the Interregional Highway network. Right-of-way for Highway 360 now is being acquired, and the construction of this important link to dual-lane State Highway 183 and the Fort Worth International Airport to the north is assured.

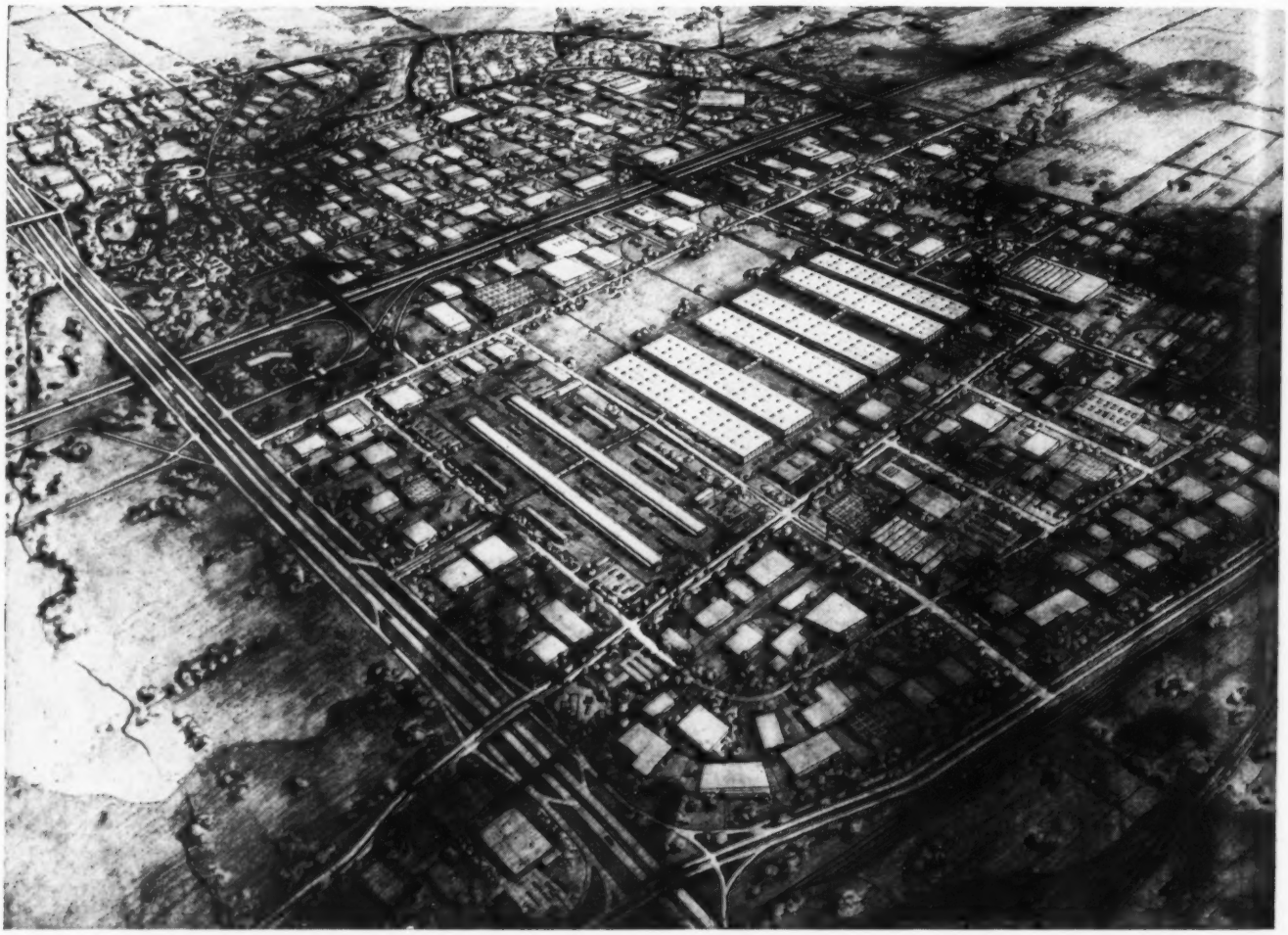
Quick rail connections on all ten rail lines entering Texas are available by way of the Chicago, Rock Island, and Pacific Railroad, which has acquired right-of-way for a connection from the District to its main line a few miles to the north, and by the Texas & Pacific Railroad, with its main line immediately south of U.S. Highway 80.

The Great Southwest Industrial District, or GSID, is planned for development by stages. Two areas are now in the construction phase. Industrial Community No. 1 lies immediately north of the Turnpike, and is being prepared for individual industrial sites. Industrial Community No. 2 will contain individual sites, but its main purpose is to provide a warehouse and truck terminal with outstanding facilities to serve the whole Dallas-Fort Worth metropolitan area.

The master plan of GSID was prepared by Associated Architects and Planners, with O'Neil Ford, R. S. Colley, A. B. Swank, and S. B. Zisman as principals. Specialized consultants were called in during the planning stage to advise on trafficways, railroads, and the warehouse layouts. The

THE COMMUNITY CENTER FOR AREA NO. 1 IS SHOWN BELOW IN AN ARCHITECTURAL RENDERING AND AT RIGHT IN PLAN VIEW. AREA INCLUDES RESTAURANT, SHOPPING CENTER, CHURCH, AND OFFICE BUILDING.





AERIAL PERSPECTIVE SHOWS AREAS NO. 1 AND NO. 2. THE TRUCK TERMINALS AND WAREHOUSES ARE IN THE CENTER.

master plan covers the entire 5000 acre tract, from which Industrial Communities No. 1 and No. 2 were selected.

Engineering aspects of this project are those expected for a new development, but there are some notable factors which set GSID apart from the normal. These include topography, the size of the ultimate undertaking, special economic problems, and the division of GSID between two separate municipalities.

Topography

GSID occupies an area of rolling prairie land marked by draws and valleys. It is traversed from west to east by Johnson Creek, a stream of considerable importance during wet weather — and weather has been rather wet of late. Drainage for all but a small portion of GSID is carried into Johnson Creek by the draws and valleys, which flow in a generally north or south direction. Johnson Creek is wide and flat in its over-all section. However, smaller valleys formed by the draws are characterized by gradients of 1½ to 2 percent, with side wall slopes ranging from 3 to 15 percent. Two of these draws have proven significant in the areas now under development. These two draws are dry and innocent looking during the extended dry spells which characterize this section of the country, but they drain large areas and carry torrents of water during storms.

Size of Project

Proportions of GSID can well be envisaged by its approximate maximum over-all dimensions — eight square miles. While material quantities have not been estimated as yet for the entire project, the 2300-acre northern section provides some idea of the magnitude of the engineering improvements. In the northern half alone there will be approximately 386,000 feet of water, sanitary sewer, and storm sewer construction, of which 82,900 feet is now under contract, and 764,500 square yards of paving, of which 177,000 square yards is now under contract. The size of the project also means design factors for drainage areas measured in hundreds of acres and for an estimated ultimate population of over a hundred thousand persons working in hundreds of industries.

Business Economics

The site for GSID was chosen primarily for its strategic location in the center of the Dallas-Fort

Worth metropolitan area with its remarkable transportation facilities, plus the fact that a large area of undeveloped property was available in one tract. These advantages were deemed sufficient to justify the extra effort and cost required to transform the topography to fit an industrial layout. In the development phase of GSID, good business sense dictates a minimum outlay of funds for construction until revenue from the project becomes available. Accordingly, early contracts are being prepared for construction of only those improvements that are essential to the areas of initial development. Generally, it has been possible to design these first improvements so they may be incorporated without duplication or loss of efficiency into the ultimate systems as the project develops.

Political Subdivisions

GSID, with its 5000 acres, is as large as a fair-sized city, but a part of the area (approximately 500 acres by Grand Prairie and 1800 acres by Arlington) was already under first reading when it was acquired. Since that time, both cities have passed final readings so that the entire property now lies in one or the other. This condition has not presented a great obstacle, but it has raised questions based on differences in city policy. The greatest difficulty has arisen in the platting of Industrial Community No. 1, where the limit line dividing the two cities cuts due east and west across the property. This has required special consideration in preparation of the plat and in the design of the water system.

A minor problem having to do with the need for separate water systems to serve Industrial Community No. 1 will resolve into an advantage in the ultimate layout, as it is planned to install reversible flow meters in at least two points to interconnect the two systems. This will provide GSID with two major sources of water. Currently, the problem will be solved by connecting the systems in two places with valves that normally will remain closed.

Preliminary Studies

The master plan for GSID was developed by Associated Architects and Planners on a scale of 1″ = 400′. Their work was based upon contour maps prepared by aerial photogrammetric methods on the same scale and with a contour interval of five feet, and a property map prepared from deed records.

Engineering studies began in May 1956, with the first preliminary analysis of grading. This analysis, approximate as it was, disclosed the need for a great deal of earthmoving to develop the required grades. Shortly after this, prior to development of a grading plan, the first grading contract was awarded. This would appear hasty, but it took advantage of a good bidding atmosphere at a time when several large grading contracts on the Turnpike were nearing completion — and it provided equipment for a ground breaking ceremony of proportions appropriate to the size of GSID. A grading plan to move 300,000 cubic yards of dirt from an obviously high area into a draw that would require fill was quickly prepared, and work began. The grading plan for Industrial Community No. 2 was continued to permit extension of the initial contract.

Preliminary layouts for water, sanitary sewer, and drainage lines were prepared for the area east of State Highway 360. Design criteria for industrial areas, including adequate fire protection, were considered in the design of the water system. This plan was reviewed and approved by the Fire Protection and Engineering Bureau of Texas.

The pattern for the sanitary sewerage system was pretty well defined by the City of Arlington's new 30-in. outfall sewer down Johnson Creek to a new 5-mgd disposal plant. The whole area of GSID drains to this sewer with the exception of the valley of the large draw across the southeast part of the project. This valley drains across Grand Prairie east of GSID. Portions of this valley now being developed in GSID will be sewered through lift stations discharging into the system flowing into the Johnson Creek outfall until such time as Grand Prairie extends its facilities to provide service.

Sanitary sewers follow the topography and ignore political subdivisions, so a large area of Grand Prairie will be sewered into Arlington's outfall sewer and disposal plant at the present, and in the future, a large area of Arlington will be served by Grand Prairie facilities. The two cities have an agreement regarding these services.

Through the advantage of good natural drainage, the preliminary drainage plan was defined by topography, modified to some extent by the grading plan. Drainage systems were laid out to follow drainage courses except in instances of realignment to avoid conflict with the master plan pattern.

Drainage problems in GSID are distinctly different from those encountered in most industrial areas in this vicinity where many are located in low, flat flood-plain areas reclaimed by levees. In such districts, the problem is generally to get enough fall, frequently working between narrow ranges from warehouse floor elevations to high water elevations in flood storage basins. In GSID, there is gradient to spare and, while there is a flood condition to consider in Johnson Creek, it is far removed from building sites. Johnson Creek, itself, has been recognized from the beginning of the project as an ideal park area.

Design Phase — Surveying

The only maps available of GSID at the time engineering design work began were the contour map and the master plan. There was no up-to-date survey of the area.

Brookes Baker, Surveyors, of Fort Worth, were

retained to make an accurate boundary survey of the property and prepare the boundary plat. This property was familiar territory to John Baker, who now heads the third-generation firm of surveyors. An allowable error of 1 in 10,000 was specified for this survey; the work was closed with an error of 1 in 11,000 or better.

In the meantime, parallel base lines on each side of the Turnpike were being established and tied in to the horizontal control net for the Turnpike. These base lines, running due east and west, were used to set up triangulation nets over the entire project. They were tied in to the Texas State Coordinate System (Lambert projection), which had been used on the Turnpike, and coordinates based on this system were computed for all control points. Likewise, the completed boundary survey, after necessary adjustments were made, was coordinated. Bench mark level circuits were run between a U.S. Coast and Geodetic Survey bench mark at the southeast corner of GSID, a Texas Highway bench mark on U.S. Highway 80, and three Turnpike bench marks spaced about equally across the site.

Standard survey equipment and methods were used for both horizontal and vertical control. Care and accuracy were required of the field parties, and very good results were obtained. All work was checked and closed in the field. While the closures of one or two hundredths for each circuit no doubt had compensating errors, the consistency with which circuits checked with each other indicates a reliable system of bench marks over the entire project.

Platting and Computation

Due to the urgency of getting construction under way, platting and computation on GSID actually followed the start of grading operations. This turned out to be an advantage, as it became necessary to alter the platting to reduce the grading quantities, particularly in Industrial Community No. 1. Both Communities were laid out in rectangular pattern by the planners, simplifying the computations in a way very refreshing to a computing section accustomed to working with curvilinear residential plats for several years. The only curves encountered were railroad curves, and these were, in most instances, repetitious throughout the plat. However, it was found that the plat of Industrial Community No. 1 would fit the ground much better by warping the pattern, which made every block and nearly every tract a problem within itself.

Platting was based upon key distances and angles scaled or protracted from the $1'' = 400'$ scale master plan. From these controlling dimensions, the remainder of the courses and distances were computed, each block being closed on itself and each segment within the blocks, as divided by railroad strips, being closed on itself. All points of intersection, curve ends, and block corners were coordinated and will be accurately and permanently monumented on the ground as construction is completed.

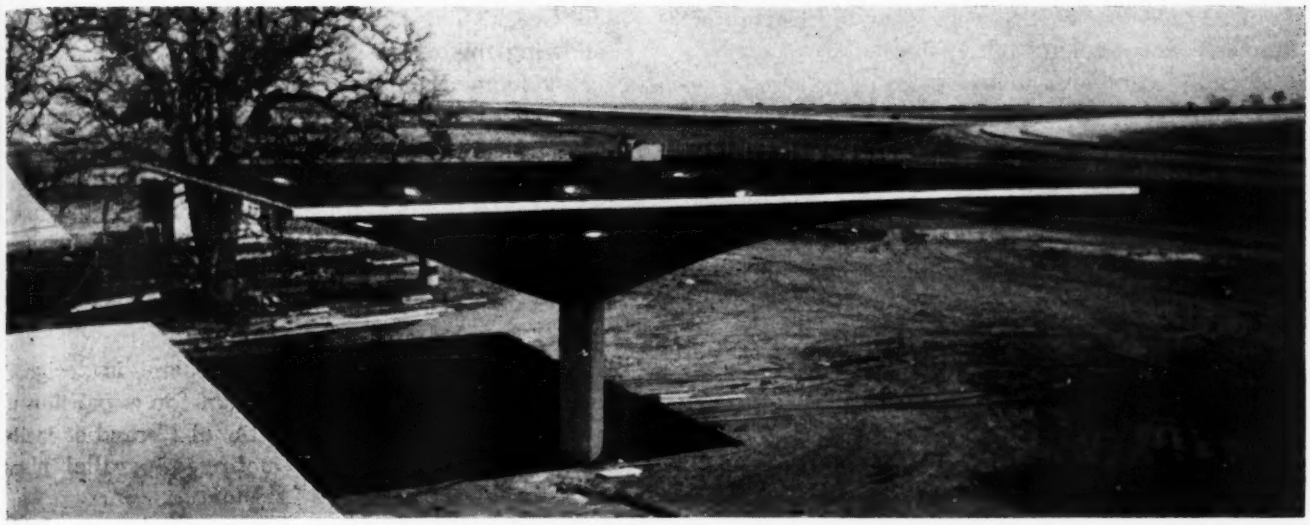
Each plat is prepared on a scale of $1'' = 200'$, which is a convenient scale for use during computing and also provides a suitable base map for inclusion with improvement plans. These base maps also serve as key maps for the filing of plats, which must be prepared on a scale of $1'' = 100'$ to meet the requirements of Arlington and Grand Prairie. A slight complication developed in Industrial Community No. 1, divided between the two cities, in that Arlington requires plats on 22" x 36" sheets while Grand Prairie requires 24" x 30" sheets. This plat was drawn up on one large hard copy and traced off on sheets of the proper size for each city.

Grading

Grading plans of Industrial Communities Nos. 1 and 2 have two things in common — they each require the movement of large quantities of earth, and it is difficult to obtain allowable railroad grades without moving even more earth. The first grading operation took place in Industrial Community No. 2, with the award of a contract for 300,000 cubic yards in May 1956. The grading plan for this initial contract was, of necessity, prepared from sections platted from the contour map. This contract has been extended and the grading plan completed, based upon cross-sections, the entire area of both communities having been sectioned on a grid system measuring 200 feet each way. These grid elevations are supplemented by elevations defining ridges, draws, and grade breaks.

Elevations for the most part have been platted on long east-west sections, but where increased accuracy can be obtained, they have been platted on shorter north-south sections. These sections are used first for laying grades and, finally, for computing payments by the method of average end areas.

Grading requirements for Industrial Community No. 2 were set by the warehouse - truck terminal complex. This complex consists of three pairs of warehouses nearly 1600-ft long, each pair being served by a common railroad strip and each being flanked by large truck maneuvering areas, and of two truck unloading docks extending for a distance of 1900 feet. The whole complex is served by a "Towveyor," an endless chain device for moving warehouse trucks. The north-south length of warehouses and truck docks demands zero grades. Zero grades are also desirable in the east-west direction, because of the Towveyor. However, a desired maximum grade of two percent was allowed when it was found that topography would not allow zero grades both ways. These criteria defined the grading problem for the warehouse area, and from there it became a matter of juggling grades to reach balanced cut and fill quantities. The planners wisely set the warehouse and truck terminal complex on the



CLUB RESTAURANT IN THE COMMUNITY CENTER IS OF TYPICAL CANDELA HYPERBOLIC PARABOLOID DESIGN.

largest and flattest hilltop they could find, but it was not large enough or flat enough for the requirements. Nearly two-million yards of dirt will be moved to complete grading in Industrial Community No. 2.

Industrial community No. 1 grading problems were centered around the rail layout. This area is characterized by a series of draws and finger ridges pointing north to Johnson Creek. The most attractive layout provided a pattern of long streets and rail strips running east and west across the development. This plan, however, forced the rails across the steep walls of the draws and also created a series of lows in the streets which could not be drained without expensive storm sewer construction. This plan was unworkable without a tremendous grading effort, and was discarded.

The alternative plan provided north-south streets and rail strips, with an east-west street paralleling the Turnpike on the south and another paralleling and adjacent to Johnson Creek on the north. This plan originally followed a rectangular pattern — except for the winding street along Johnson Creek — until it was found that grading quantities were excessive. It then was discovered that by twisting the layout about 14 degrees out of square, the streets fell in the draws, and the rail strips landed on top of the ridges. This slight twist reduced earth quantities by more than 300,000 cubic yards, which more than justified the additional work required for platting.

The rail layout in Industrial Community No. 1 served as a backbone whose grades governed the entire grading plan. A maximum rate of grade of 1½ percent was used for lead tracks, with 5 percent as the maximum for streets. Industry sites were graded to drain from rail strips to streets with slopes between 1 and 4 percent. The 1½-percent grade on the railroad lines, while steep compared to grades encountered in flat land developments, does not present a problem in view of the vast area.

These criteria defined the problem for the grading plan of Industrial Community No. 1. The series of north-south draws and ridges, with their side slopes as high as 15 percent, had to be equalized — the highs cut down and the lows filled. Further, with the general north-south gradient of around 5 percent in this area and with a series of north-south rail lines set to a maximum grade of 1½ percent, it was necessary to tilt the entire plane of the development between the Turnpike and Johnson Creek. This permitted a balance of cut and fill quantities in excess of a million cubic yards of earth.

Soil underlying GSID is generally composed of clays, including some sandy clays. It is underlain by shale at a depth of around 40 feet and contains some strata of hard sand rock. The material encountered in grading operations has consisted of the clays, and has been handled easily by the rubber-tired pulls. The specifications called for sufficient equipment to prosecute the work at the rate of 20,000 cubic yards a day, a figure which has been regularly exceeded by the contractor. The specifications also called for fill to be placed in compacted layers with density of 90-percent Proctor, to minimize subsequent settlement. This is important in that streets, with utilities, are generally in the fill areas.

Drainage

The topography of GSID assures rapid run-off of storm waters in well-defined drainage courses. The grading operations have changed the sections and, to some extent, the location of these drainage courses, but not their existence. Storm water is carried in the streets to the extent that gutter sections are adequate, after which it is picked up in storm sewers. Even with the favorable grades throughout, extensive storm sewer construction is

required because of the very size of the project and the concentrations anticipated.

Storm sewers are designed for storms of five-year frequency, using imperviousness factors of 90 percent in the warehouse and truck terminal area and 70 percent on the remainder of the project. Flood stage for Johnson Creek is based on a 25-year storm frequency, and sewers discharging into the creek are designed to operate under those conditions.

The two major drainage courses passing through GSID, other than Johnson Creek, will require large-sized conduit when they are enclosed. The draw heading in Industrial Community No. 2 and draining north through Industrial Community No. 1, drains over 200 acres and will discharge 370 cfs into the creek during a five-year storm. The draw cutting through Industrial Community No. 2 drains 50 acres south of U.S. Highway 80, and a total of 310 acres as it leaves the area of initial development. This drainage will be designed for a flow of 600 cfs during a five-year storm. These two drainage courses are being left open at present, except in areas of immediate development.

Water Supply and Sanitary Sewers

Water for GSID will be supplied by Arlington and Grand Prairie within their respective limits. Each city is able to supply the water required for initial development, and each has a program of staged construction designed to keep abreast of estimated GSID demands. Both Grand Prairie and Arlington have supplemented their original well supply, Grand Prairie having a connection to the Dallas water system and Arlington a connection to the Fort Worth system.

The master water plan contemplates a 24-in. main, or its equivalent, traversing GSID and connecting the Arlington and Grand Prairie systems through a reversible flow meter. This arrangement will provide the district with a dual source of water and will benefit the two cities by providing additional pressure in case of emergency. The water plan is based upon estimated light industry demands, with ample allowance for fire protection. Cast iron or steel-cylinder prestressed concrete pipe will be used throughout. The first contracts for water mains have been for 12- and 16-in. lines, which will be adequate for initial development and will become secondary loops in the ultimate system.

The sanitary sewerage system for GSID naturally falls into three major divisions, the largest being the area comprising all of Industrial Community No. 1 and about the north third of Industrial Community No. 2 which drains directly into Arlington's 30-in. outfall sewer along Johnson Creek. This has been subdivided for economy of construction into two systems, one emptying east and the other west.

The west end of Industrial Community No. 2 drains to Highway 360, which drains north to Johnson Creek. This area will be sewered separately, following this drainage course.

Development in the third area, which drains to the east through Grand Prairie, will be sewered by way of a lift station into the Johnson Creek system. The initial development in this valley is somewhat limited, and the use of lift stations is indicated until such time as development in Grand Prairie justifies the construction of a trunk sewer. Use of package lift stations is contemplated to permit re-use at other locations in later development.

The Arlington sewage disposal plant is designed for 5-mgd capacity with provision for expansion to a capacity of 10-mgd. An additional 10-mgd capacity can be provided by constructing a parallel plant on property already acquired for that purpose.

Paving

Streets in GSID are planned in three widths of right-of-way — 80, 100, and 120 feet. Paving sections on these streets are 60 and 80 feet face-to-face of curb on the first two, and dual 40-ft lanes with median strip on the 120-ft right-of-way. In the initial stages of construction, all streets will be paved as dual 22-ft lanes, with outer curbs in their final position. The wide median will be planted until such time as additional roadway width is required.

A pavement section of 7-in. asphaltic concrete with 30-in. concrete curb and gutter, all on a 6-in. sand-clay base, was selected as the best design at greatest economy. This decision was reached after considering a number of flexible base designs and subbase stabilization treatments. Sand for base treatment is available on the site, and the cost of asphaltic concrete was competitive with built-up flexible base designs.

Criteria of Improvements

The nature of GSID and the expressed intention of making it a select site for industry, make mandatory a high standard of design and construction. Design factors and specifications are in keeping with these standards. All construction is planned to give long years of service at low maintenance cost.

However, the initial construction costs are being held to a minimum consistent with the nature of the project until revenues make GSID self-sustaining. This is being done by scaling down the scope of construction rather than by skimping on design. Thus, all improvements now being installed are designed to fit into an ultimate over-all plan. This plan, while formulated for the entire project, must remain flexible because of the impossibility of predicting the full nature or direction of development. GSID is so large and offers so many features to industry of every type — other than very heavy manufacturing or processing — that improvement plans and platting must be subject to change to meet the future requirements. ▲▲

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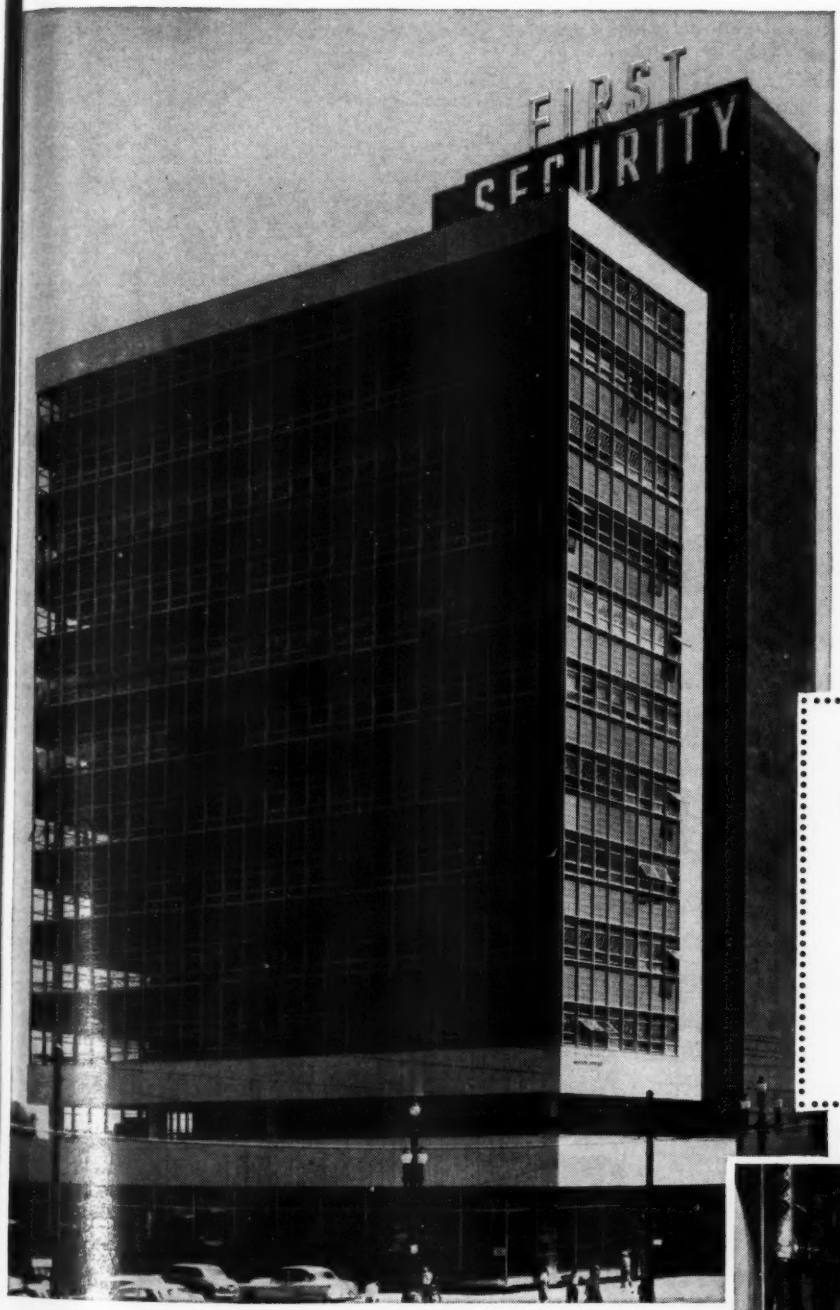

Salt Lake City's new First Security Building is ultra-modern in more than just appearance. It features dual zone air conditioning in which *steel pipe* serves for the steam, chilled water and condenser water lines throughout the 12-floor *heating and cooling* system. Nearly a mile of steel pipe—40,000 pounds— from the basement boiler and chiller installation to the penthouse condensers was required.

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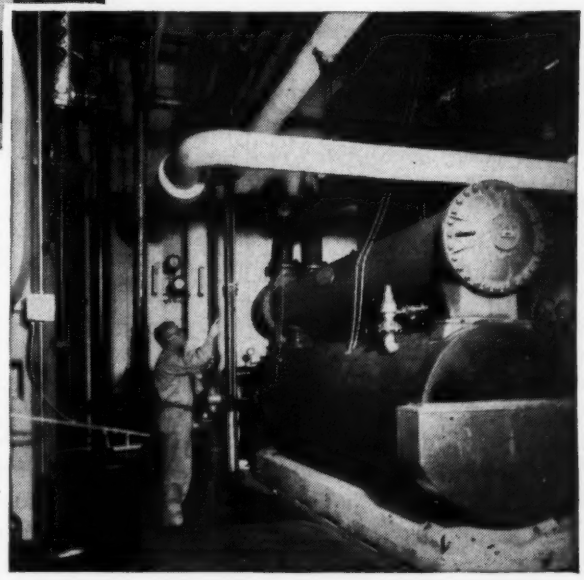

Steam boiler and water chiller equipment for the dual zone air conditioner are compactly housed among this maze of steel piping.

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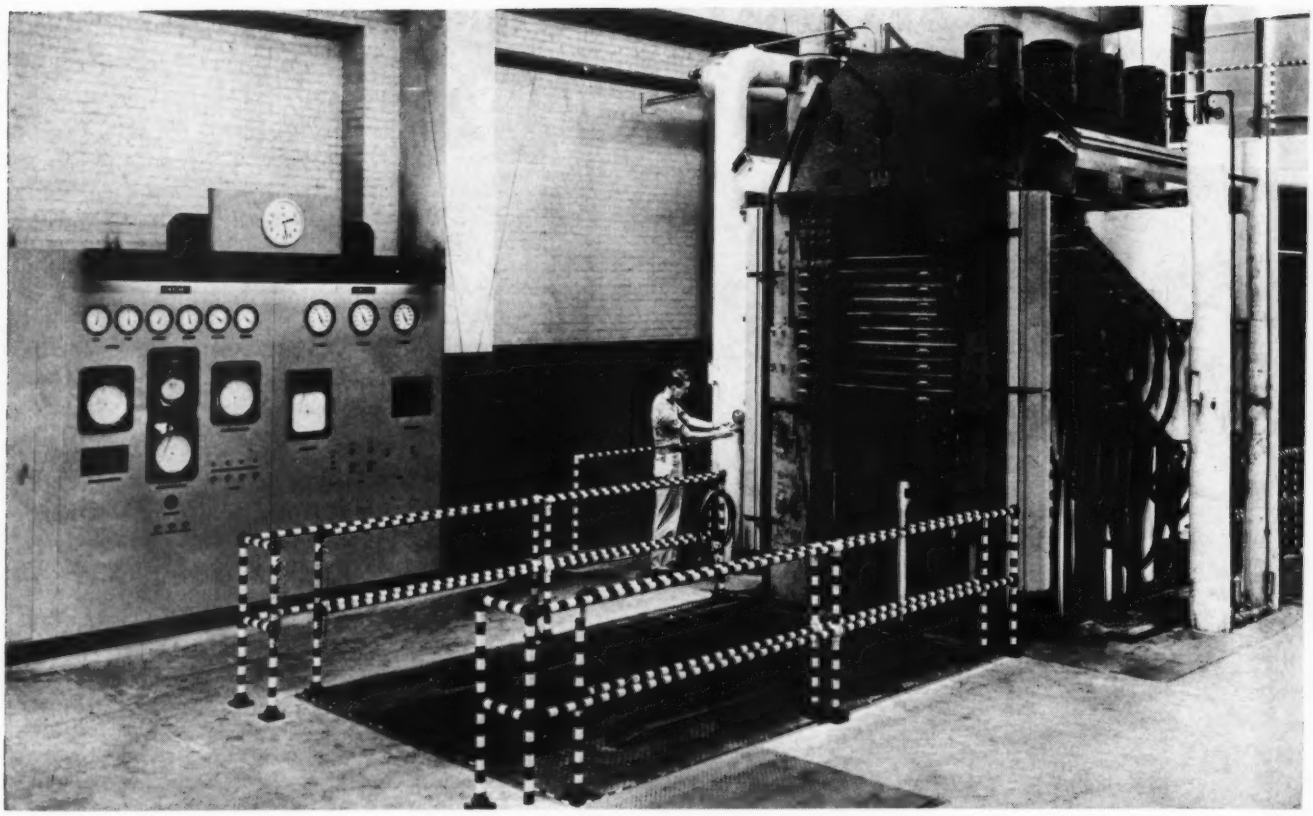

HEATING PLATENS WITH HIGH TEMPERATURE WATER MAKES POSSIBLE AUTOMATIC PROGRAM CONTROL FOR THIS PRESS.

High Temperature Heating With Liquids

BERNARD S. BREITMAN, Associate
American Hydrotherm Corporation

Bernard S. Breitman obtained his Bachelor's Degree in Mechanical Engineering from the College of the City of New York in 1947 and his Masters Degree in Mechanical Engineering from New York University. He did post-graduate work in thermodynamics and heat transfer at the University of Wisconsin. Mr. Breitman was an instructor in thermodynamics and heat power at the College of the City of New York prior to joining American Hydrotherm Corporation. He has been with American Hydrotherm since 1948, with the exception of an extended leave of absence spent with the Electric Boat Division of General Dynamics Corporation, where he worked on heat transfer applications for the first nuclear powered submarines, the Nautilus and the Sea Wolf. In 1956 he became an associate in the firm. He holds a professional engineer's license in the State of New York and is a member of the National Society of Professional Engineers, the American Society of Mechanical Engineers, the Air Force Association, and Armed Forces Chemical Association.

MANY MODERN INDUSTRIAL processes require high temperature, uniform heating by means of an indirect heat transfer medium. Consulting engineers in serving their clients should be familiar with these high temperature heating systems. They should understand their process applications, the available heat transfer media, and the thermal system equipment for handling the fluids.

Advantages of Liquid Heating

Liquid heating systems, in general, are more advantageous than vapor or gas heating systems for process applications requiring close temperature control, uniformity of temperature across the process heat transfer surface, and alternate heating and cooling cycles.

Unlike vapors, liquid flowing through a tube has the same film coefficient of heat transfer at any point

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On the other hand, condensing vapors, flowing through a tube or passage, produce a heat transfer rate that is higher in the region of the top surface of the tube, and lower towards the bottom. This is due to the collection of condensate at the bottom. The rate of heat transfer declines more and more towards the outlet where there is more condensate.

Test Results

Exact investigation of this subject has been conducted by the late Prof. Max Jakob. Fig. 1, reproduced from Jakob's *Heat Transfer,* shows the distribution of film thickness around the passage perimeter. Quoting from this work, "In these tests, the temperature at the bottom was found to be much smaller than at the top, because of the increase of film thickness from top to bottom. The flow of condensate in axial direction caused an increase of this difference in the flow direction."

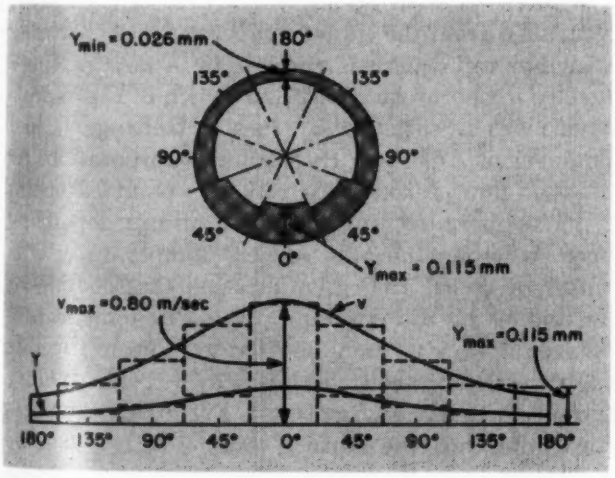


FIG. 1—STUDIES BY JAKOB SHOW THICKNESS AND VELOCITY OF WATER FILM INSIDE A HORIZONTAL TUBE IN WHICH FLOWING STEAM IS CONDENSING.

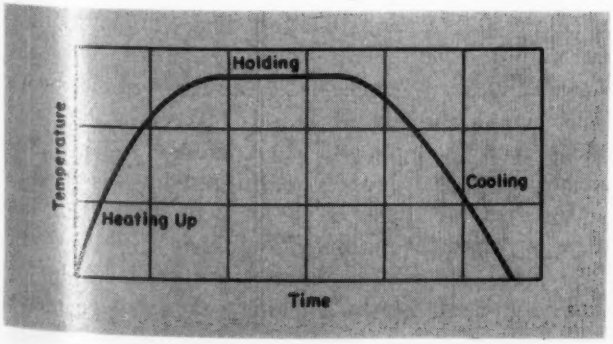


FIG. 2—TIME VS TEMPERATURE CHART FOR TYPICAL PLASTIC PRESS HEATING AND COOLING CYCLE.

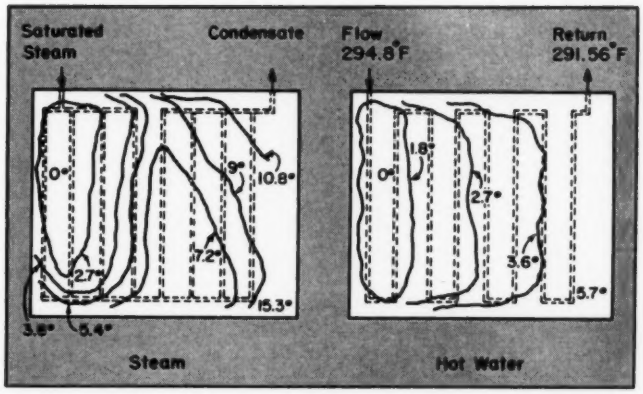


FIG. 3—COMPARISON OF PLATEN SURFACE TEMPERATURE FOR HOT WATER AND STEAM HEATED PRESSES.

For processes requiring alternate heating and cooling, it will be apparent that the use of the same heat transfer medium for both cycles will allow a completely closed cycle to be maintained at all times. The use of vapor heating and liquid cooling on the same heat transfer surface introduces air and impurities into the system and results in scaling and other harmful effects.

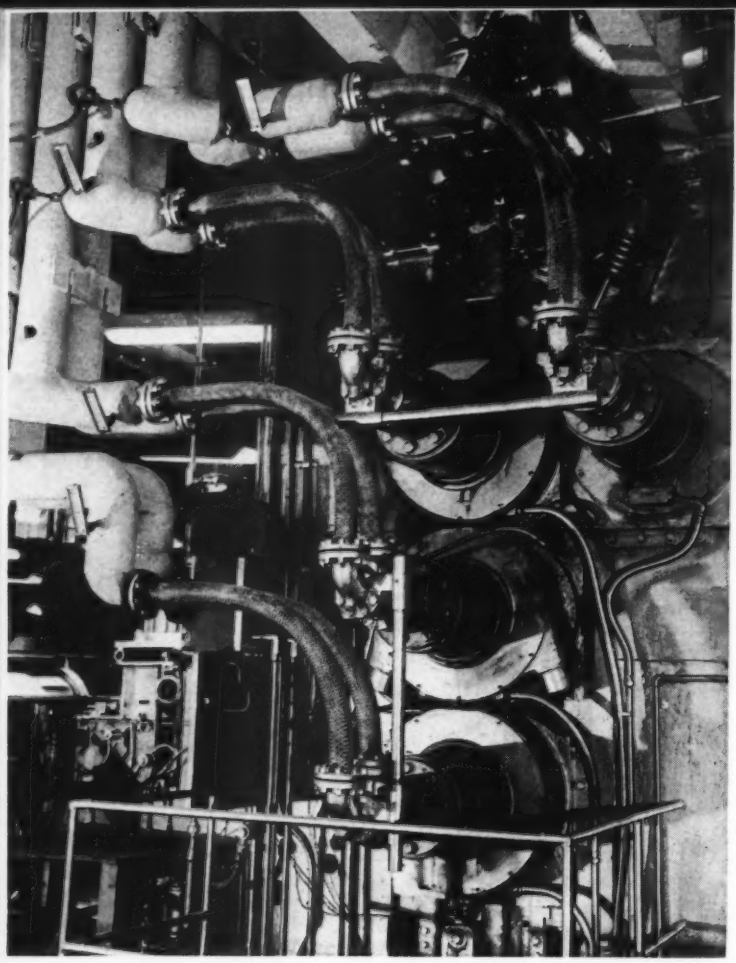
Further, the application of controlled rate of heating or cooling through the use of programming controls is essential to certain processing procedures, such as in plastic laminating and metal bonding, and this can be accomplished most readily by the use of a liquid heat transfer medium.

Process Applications

Platen press processing finds important applications in the plastics, hardboard, chipcore, and metal bonding industries. Processing requirements call for thermal gradients to be applied between the platen and the work by means of a heating or cooling agent flowing through passages in the platen. One example of a process cycle is given in Fig. 2 which shows a typical temperature vs time curve required for a plastics press.

It is important to maintain the surface temperature as uniform as possible, especially during the holding cycle, as this usually has a direct bearing on the properties of the finished product. Fig. 3 shows a comparison of surface temperature uniformity for a platen heated by steam, and for a platen heated by water of equal inlet pressure and temperature.

In a platen press used for the production of decorative laminates the temperature of the platens must be coordinated with the pressure applied on the laminates, and the temperature control equipment works directly in conjunction with the hydraulic cycle which controls the pressure applied on the work. At the plant shown in the photograph of the platen press, the temperatures applied to the platens are controlled automatically throughout the cycle by



LIQUID HEATING MAKES IT POSSIBLE TO HAVE EACH CALENDER ROLL AT A DIFFERENT TEMPERATURE.

means of a cam operated program control system. The temperature program controls are shown on the left panel, and the controls for the hydraulic cycle are shown on the right panel. An automatic program control such as this only can be accomplished by using a liquid heat transfer medium, which in this installation is high temperature water.

Calenders

High temperature liquid heating and cooling systems have gained such prominence in calendering applications for the plastics, rubber, and other industries using this production method, that virtually all new calenders are being designed to accommodate liquid heat transfer. For example, the four-roll calenders shown in the photograph are used for processing plastics such as vinyls. The plastic is forced into banks before being forced through the nip between pairs of rolls. In these banks substantial frictional heat is created in the plastic. This, together with heat conducted from the roll, produces the proper processing temperature. Depending upon the operating conditions, each roll must be maintained at a different temperature, which may represent either heating or cooling.

Where previously the roll temperature was maintained by admission of high pressure steam or cooling water as required, depending to a large extent on the skill of the calender operator, a high temperature liquid heating system now provides completely automatic control of the operation and permits a smooth transition from heating to neutral to cooling.

For the processing of most vinyl films, roll temperatures of 300 to 350 F are required, making high temperature water the most practical heat carrier in this application. In general, a deviation in roll surface temperature above 5 F cannot be tolerated.

Thermal Circuits

Fig. 4 shows alternate thermal circuits used for calendering systems. The single roll system uses a separate pump for each roll, thereby always maintaining a constant circulation rate through the roll; the factory system makes use of one pump to circulate the heating medium, and another to circulate the cooling medium. A blending arrangement in front of each roll permits the maintenance of any required temperature. The type system to be used depends upon desired uniformity of roll surface temperatures, comparative sizes of heat exchange and pumping equipment, and other factors involved in the operation.

Whereas present liquid systems for calenders are controlled from the liquid temperature at each roll, a further refinement is possible by a new calender surface temperature control, as shown in Fig. 5. This device was invented by Mr. Paul L. Geiringer, Chief Engineer of American Hydrotherm Corporation. As the fluid flows through the roll from point 1 to point 2, its temperature suffers a rise or fall depending upon whether the roll surface temperature t_s is hotter or cooler than t_1, indicating that cooling or heating of the roll is taking place. The temperature difference $(t_1 - t_2)$ may be used to indicate the rate and direction of heat transfer, provided the quantity of flow is practically constant. From this temperature difference the surface temperature t_s can be computed by the device, and the liquid temperature t_1 automatically adjusted to keep t_s constant at any desired level. This principle is the basis of the patent.

Kettles

The heating of kettles and reactors with jacketed or internal coil construction finds application in many industries, such as paint and varnish, chemical, drug, and pharmaceutical. A common but erroneous objection to the use of liquid heating in these applications is that heat will be transferred much quicker if a condensing vapor heating medium is used.

However, it must be recognized that the controlling resistance to heat flow exists on the process fluid side, and even substantial differences in the film coefficients of the various heat transfer media under consideration have little effect on the over-all coefficient of heat transfer.

A comparison of the film coefficients of a con-

densing vapor versus its liquid will further indicate that, with properly designed velocities, the liquid media often will produce a higher coefficient. For example, an average value for the film coefficient for condensing Dowtherm vapor is somewhat over 200 Btu per hr per sq ft per deg F, a value which easily can be exceeded by Dowtherm liquid.

A photograph shows the control panel for a thermal liquid heating and cooling system serving a 3500 gallon glass-lined kettle used in the manufacture of heat and light stabilizers for polyvinyl chloride. The thermal liquid used in this project is Aroclor, operated at a maximum temperature of 550 F.

In order to provide good circulation rates of the liquid, the jacket should be properly baffled, or agitator nozzles should be employed. A more recent dimpled jacket design also provides good circulation characteristics.

Miscellaneous Applications

High temperature liquid heating media advantageously serve process equipment such as ovens, autoclaves, and chemical process heat exchangers. Liquid heating is generally to be preferred in designs using long banks of coils, thus avoiding the possible blanketing effect of condensate. This allows controlled circulation with accurately predictable heat transfer rates.

Liquids make possible the use of heat-accumulator systems to relieve the instantaneous load on the heating plant. Fig. 6 shows a liquid heating and cooling system incorporating an accumulator which stores high temperature liquid during the nonheating portion of the process cycle. Fig. 7 shows a comparison between the instantaneous steam consumption of a typical platen press and that of the same press heated with water with and without an accumulator. High temperature water requires a maximum rate of 13.5 tons of steam per hour compared with a rate of 17 tons of steam per hour for steam heating. When an accumulator of 875-cu ft capacity is added to the system, the maximum rate of steam consumption is reduced to only 6 tons per hour.

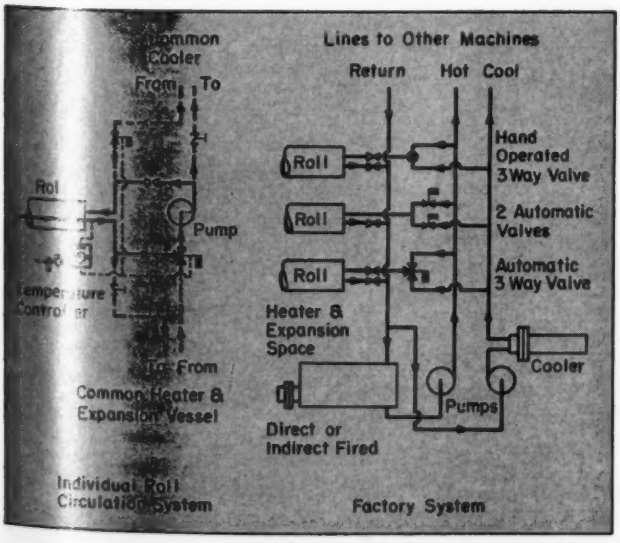


FIG. 4—COMPARISON OF SINGLE ROLL SYSTEM AND FACTORY SYSTEM FOR CALENDERING MACHINERY.

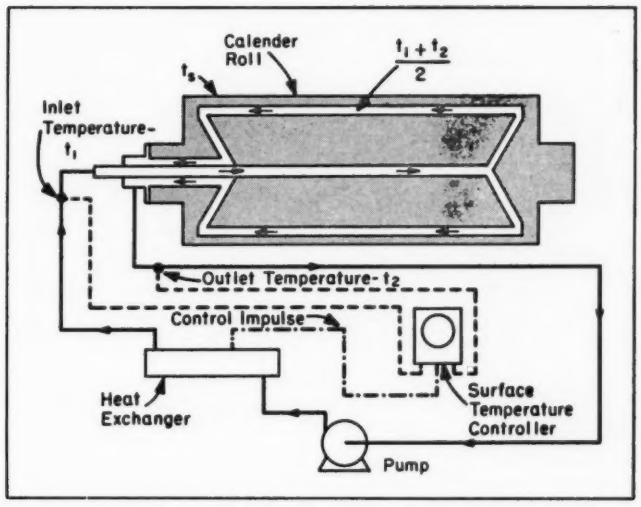


FIG. 5—CONTROL SYSTEM AUTOMATICALLY FITS INLET TEMPERATURE TO DESIRED SURFACE TEMPERATURE.

Liquid Heat Carriers

After reviewing the applications and advantages of liquid phase heating systems, it is interesting to survey the field of available liquid heat carriers, their temperature ranges of operation, and notable physical characteristics. The following tabulation lists a number of currently used liquids together with the approximate temperature ranges in which they have been applied.

Liquid Heat Carriers

Recommended Operating Temperatures—Deg F

	Minimum	Maximum
Water	40	400-450
Heat Transfer Oils	100	500-550
Aroclors	50	550-600
Aryl Silicates	0	600-650
Dowtherm	70	650-700
Eutectic Salts	320	1000-1200

Of all the compounds available, water is by far the best heat carrier. It has the highest specific heat and the best heat transfer properties. It has the great disadvantage, however, that at temperatures above 450 F, its vapor pressure becomes too high and the equipment required for containing it becomes too expensive compared to that for other liquid heat carriers.

Hydrocarbon heat transfer oils operate in unpressurized systems, but generally have the poorest heat transfer properties and the highest viscosities at lower temperatures. Aromatic heat transfer oils have been developed in recent years that allow a

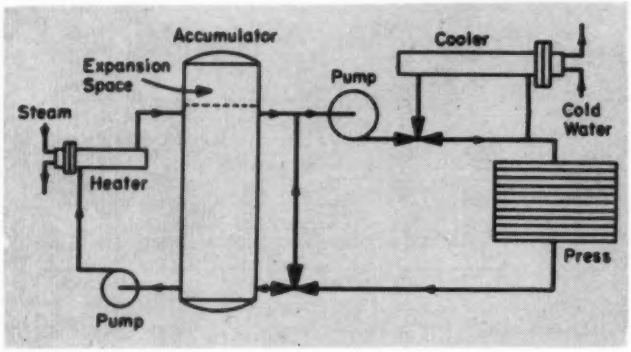


FIG. 6—ACCUMULATOR STORES HIGH TEMPERATURE LIQUID DURING NONHEAT PORTION OF PROCESS.

wider operating temperature range, have good viscosity characteristics at temperatures below 100 F, and allow operation up to about 600 F.

Aroclor 1248 — chlorinated diphenyl — can be operated in unpressurized systems up to 600 F, and somewhat higher in specially designed systems. It has the very great advantage of being nonflammable and has found considerable application in processes subject to fire hazards. It can be circulated by a centrifugal pump at temperatures down to about 50 F.

The aryl silicate family provides fluids which remain in the liquid state and at negligible vapor pressure from –40 F up to 700 F. High fire points, high specific heat (up to 0.7 Btu per lb per deg F), and low viscosity characteristics make these fluids ideal for heat transfer applications in wide-range heating and cooling circuits. At present, these fluids are available only from pilot plant production, and the cost is therefore higher than for the more common heat transfer fluids.

Dowtherm A — a mixture of diphenyl and diphenyl-oxide — can be operated at temperatures up to 700 F. In well designed systems where thermal breakdown is avoided by maintaining high velocities and consequently low temperature drops across the Dowtherm film in the boiler, it may be used up to 750 F. At this temperature, the vapor pressure is approximately 160 psia. It is an inflammable fluid, and precautions must be taken in the design and operation of a system. At high temperatures, its surface tension is low and the system must be well constructed and maintained to prevent penetration and leakage.

Eutectic salts, such as mixtures of sodium nitrite and potassium nitrate, have been applied successfully in a number of plants and can be used in unpressurized systems up to a maximum temperature of about 1200 F. Thermal equipment should be of stainless steel construction for operating temperatures above 900 F. These salts have high freezing points, in the neighborhood of 300 F, and proper drainage and tracing facilities must be incorporated to handle the salt on plant shutdown.

Liquid metals such as sodium and sodium-potassium eutectics are finding some application in high temperature heating systems, especially in nuclear plants and test facilities.

The silicone group seems to be most promising as heat carriers for future high temperature heating applications. Quantities now produced are small, however, and the price is prohibitive for commercial installations.

Equipment Design

To generate high temperature water, any of the standard steam boilers may be used with modifications to permit the drawing off and circulation of water to the consumer and back to the boiler. The steam space can be used to accommodate expansion of water in the system. Forced circulation boilers offer particular advantages, especially in large multiboiler installations.

For heating organic thermal liquids, very careful attention must be given to the heater selection. One of the major problems to be met is the prevention of thermal breakdown of the fluid. Thermal breakdown will occur in that portion of the fluid which is subject to temperatures above its decomposition point. In a heater, the fluid most subject to decomposition is the film closest to the flame.

It will be apparent, therefore, that in order to operate at the highest permissible bulk temperature, the temperature drop across the film must be kept to the minimum. This is accomplished by designing for high liquid velocities producing high film co-

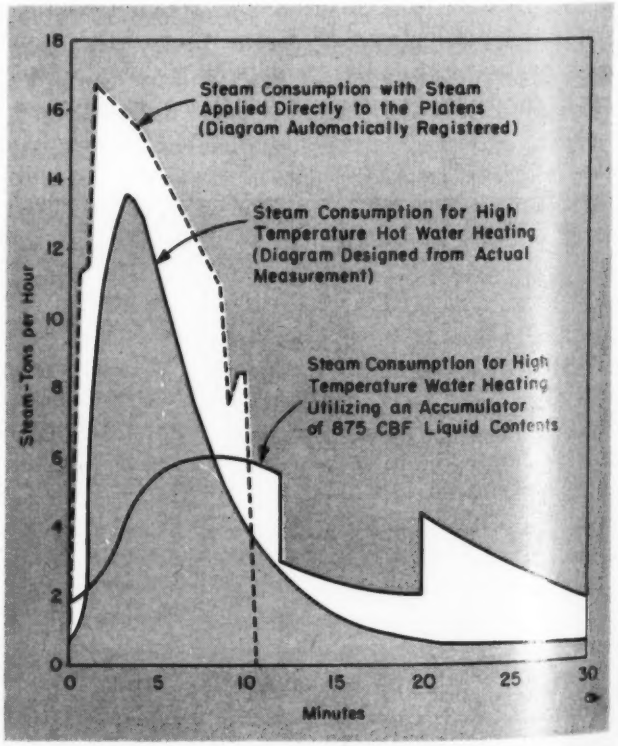
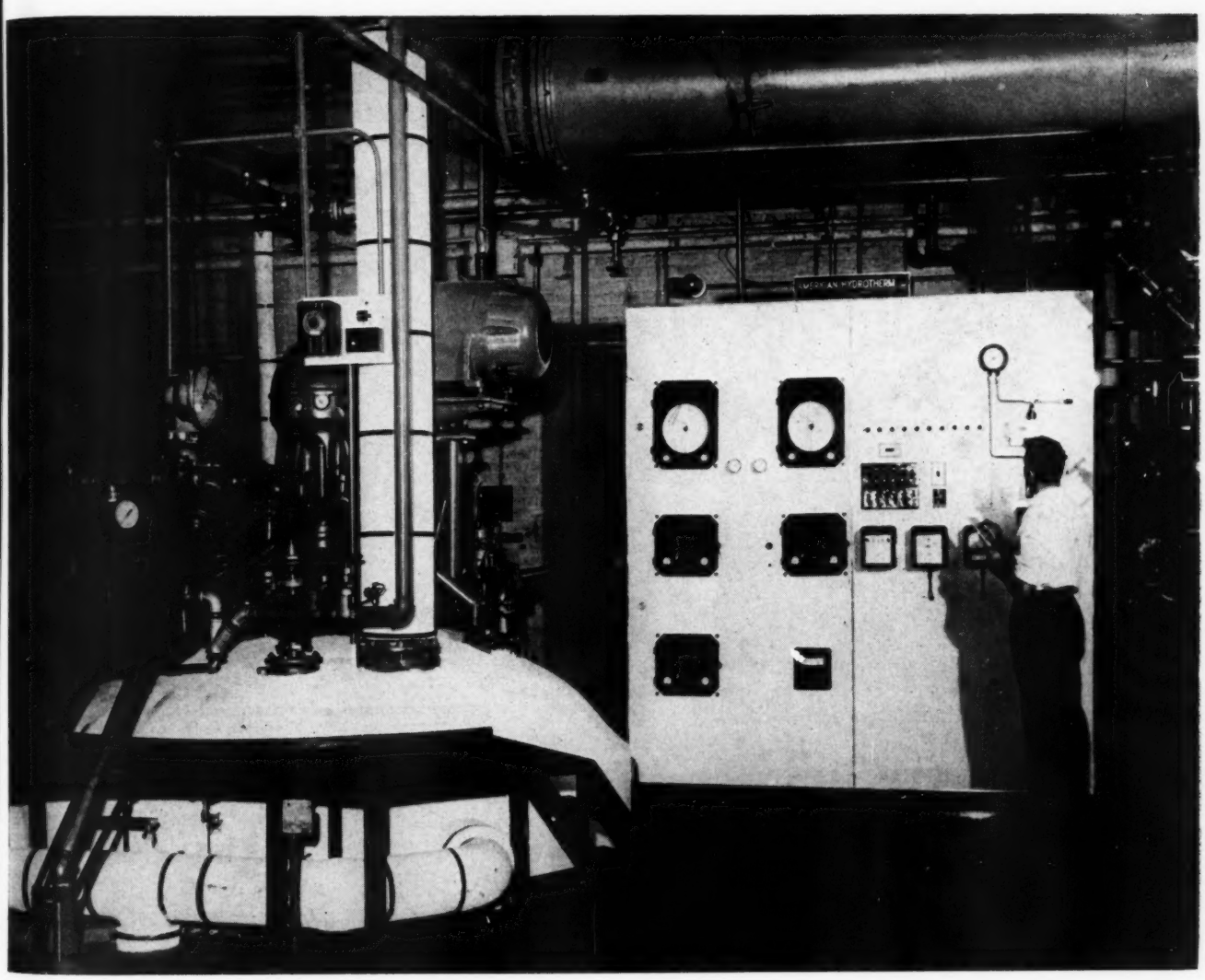


FIG. 7—COMPARISON OF STEAM CONSUMPTION FOR PLATEN PRESS HEATED IN THREE DIFFERENT WAYS.



CONTROL PANEL FOR A THERMAL LIQUID HEATING AND COOLING SYSTEM FOR GLASS-LINED PROCESS KETTLE.

efficients and low film temperature drops for a given heat flux.

Heater Types

This effect can be obtained most readily by using forced circulation water tube type heaters. Fire tube heaters, however, are now available with internal circulation and high velocities which accomplish similar results, especially in the smaller size ranges.

It is also necessary to take into account the possibility of having the circulation through the heater suddenly stopped during operation. The heat stored in the heater should not be so large as to cause sufficient temperature rise for decomposition to start in the liquid.

Circulating Pumps

The pumps used for circulation should be selected to meet the high temperature requirements. For service above 400 F, construction should be of cast steel with stainless steel trim. Bearing housings and stuffing boxes should be water cooled. Mechanical seals are to be preferred for this service.

System Construction and Trim

Piping systems for virtually all the media discussed should be standard Schedule 40 black iron pipe. All piping and fittings above 1-in. diameter should be flanged or welded, as many of the liquids have tendencies to penetrate screwed joints.

Valves specified for high temperature service must be of cast steel construction with stainless steel trim. Stuffing boxes must be equipped with a packing material adequate for the service, and must be long enough to safeguard against losses.

Future Developments

The trend in industrial processing applications is apparently toward higher temperatures and more accurate control of the process. It is to be expected that liquid heating systems will be used more extensively throughout industry, and that new thermal liquids allowing operation at higher temperatures will be developed and marketed at reasonable costs. ▲▲

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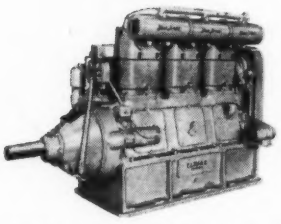
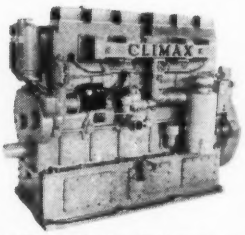
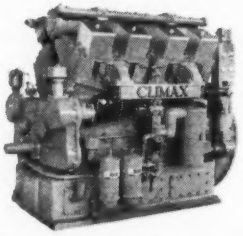
Write direct for complete information, bulletins or engineering consultation.



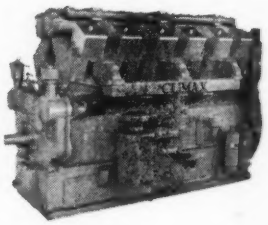
R-110—4 cylinder, 130 max. hp. at 1200 rpm.
R-165—6 cylinder, 192 max. hp. at 1200 rpm.
Ask for Bulletin SA-609



K-67—6 cylinder, 265 max. hp. at 1200 rpm.
K-75—6 cylinder, 302 max. hp. at 1200 rpm.
Ask for Bulletin SA-610



V-80—8 cylinder, 340 max. hp. at 1200 rpm.
V-85—8 cylinder, 390 max. hp. at 1200 rpm.
Ask for Bulletin SA-584-B



V-122—12 cylinder, 520 max. hp. at 1200 rpm.
V-125—12 cylinder, 605 max. hp. at 1200 rpm.
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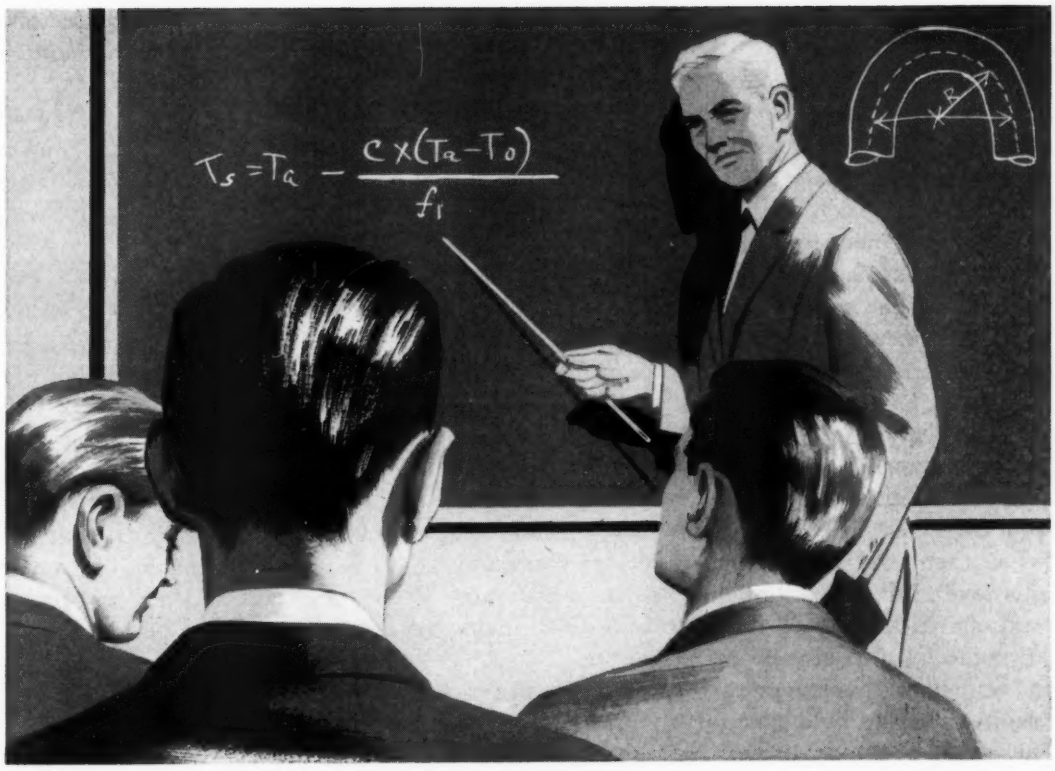

You Can Train the Men You Need

ARTHUR L. SPAET, Partner & Chief Engineer
Slocum & Fuller, Consulting Engineers

Arthur L. Spaet received his Bachelor's Degree in Mechanical Engineering from the City College of New York. Before the war he had several years of experience in the building trades and then became an officer in the U.S. Army Signal Corps during the war years. Since the war he has had ten years of engineering design experience in plumbing, heating, ventilating, air conditioning, and the other mechanical and electrical aspects of engineering design for commercial and industrial applications. He joined Slocum & Fuller in 1949 and is presently a partner and chief engineer. Spaet is a member of ASME, ASHAE, and AMA, and a registered engineer in New York State.

CONSULTING ENGINEERS, to obtain much-needed employees for today's accelerated building pace, could resort to the "I can pay more than you can" approach. But they would be sucked into an inflationary tornado, and they would be encouraging the looting of the men on their own staffs.

Besides, I have learned through experience with many of those who demand higher prices that the higher price tag rarely is proof of proficiency. And the out-of-line wages lead to prohibitive costs and are most unfair to present staff members.

Employee pools have been suggested as one road to a ready supply of personnel, and these pools have been tried in some locations. The employee pool in New York was, at one time, a successful operation. However, it is no secret that the pool presently is dried out in the current heat wave of construction until not even a telltale damp spot remains.

One Approach to the Problem

With employee pools a thing of the past, and out-of-scale salaries no answer, what can we do to fill our ranks?

Our suggestion is — train the men you need. We did that, taking on untrained men at all levels and

setting up a training program. Three years ago, we had a staff of 15. Today, as a result of our training classes, we have a well-rounded group of 50.

Our firm specializes in heating, ventilating, air conditioning, plumbing, special systems piping, drainage, lighting design, and power distribution. Our projects are such that we require an experienced senior engineer to oversee each one, but much of the detail is simplified and broken down into repetitive and fairly basic elements of design and calculation. Since a large portion of our staff consists of draftsmen occupied with this routine, finding men for that level of employment became a matter of some urgency.

Senior engineers also cannot carry out their supervisory and broad design functions without a solid base of intermediate and junior designers stationed between them and the draftsmen. We needed men of this level, but competent intermediates and juniors also are difficult to find. Most of them have good potential for advancement in their present firms, and their employers readily will give an increase in salary to hold them.

These men — the draftsmen and the intermediate and junior designers — need not be graduate engineers. They require engineering supervision, but basic design and calculation work and detailed drafting requires training, not an engineering education.

Our training program even extended to the graduate engineers we needed for supervisory work and over-all design. We went to another field from our own, usually to the engineering department of a manufacturer or to some government agency, and secured graduate engineers. These men usually were making good salaries, so it was necessary to sell them on the advantages of consulting work. Then it took as long as a year for us to train these men in our own techniques, but it proved worth it.

To summarize, the way we have increased our staff is not by trying to hire the exact men we need, but by hiring men who can be trained to do our jobs.

Details of Our Training Program

Working on this principle, it was necessary for a training program to be instigated.

We separated our operations into three basic sections — heating and air conditioning; plumbing; and electrical. The section chief supervised trainees in each grouping. He delegated the organization of classes to a top member of his staff.

Then each senior man prepared a course and lectured on one basic topic. Short quizzes and test problems followed each session. These classes were held once a week, on company time. Although many men offered to attend evening classes, we felt day classes would get better attendance and alertness.

The curriculum for juniors in the electrical section is printed in the table on page 106 to give an idea of the extent of the training course. Beyond the basis level, the training takes the form of individual coaching by the seniors on jobs currently being designed.

Installation of this training system aroused considerable opposition among our senior staff. It meant an additional load for them. Their arguments against the program were valid, and we still have problems.

More important, we have been able to carry through the training program schedule and still get our work done. We now have an excellent, balanced staff of men at various levels of ability from tracers through draftsmen, designers, engineers, and project engineers. And we have built up this staff without exceeding the going pay scales in the New York area.

Section chiefs and senior designers have seen the results and recognize the necessity for the program. Today we all consider our entire training program an important and integral part of our organization. The program cost us time, money, and effort, but the results are worth it.

Future Action

While we believe in our training program and recommend the adoption of some program of this type by other engineers in private practice, we recognize that this is not the final answer. If we assume that the national economy will continue at its present high rate of activity and that new construction and new types of projects will continue to demand all available engineering manpower, we must find new recruiting methods for our offices.

Consulting engineers, like industry, need trained and specialized men. They are in an even worse position than industry, because consultants seldom have lush cost-plus contracts. The aircraft plant or the military electronics manufacturer can pay just about anything he wants to for an engineer, and the more he pays, the more money he makes on his cost-plus basis. As long as this condition continues, the consulting engineer cannot compete with industry for engineering manpower. Not only do we fail to compete with industry's recruiting methods, but the young graduate engineer, and in many instances, a more experienced engineer, does not even know there is such a field as private practice.

What can we do?

As a short range program, the various state associations of consulting engineers should arrange for the establishment of schools in their areas. These schools could be set up as college extensions or as part of the local vocational school system. Members of the staffs of local consultants should do the teaching. In these classes, men would be trained in the basic elements of our special techniques and would concentrate on drafting and basic design.

A joint schooling arrangement financed by the local engineers would result in a growing pool of qualified draftsmen. This would serve as a reservoir

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from which, in time, would come experienced designers. By judicial use of these men, the consultant can free his present designers and engineers from routine or elementary level drafting. The carrying through of this proposal would serve the immediate need for trained drafting help.

From a longer point of view, the Consulting Engineers Council should make arrangements with colleges to let the students know of our operations and of the potentials in our field. The schools should be encouraged to institute more courses that bear directly on our work.

On a less than graduate level, the Consulting Engineers Council might establish a similar program to make us known at trade schools and drafting schools. This would serve the long-range need of establishing our requirements and our career potentials on a national scale and of assuring us enough publicity so that we obtain our reasonable share of employees. ▲▲

ELECTRICAL SECTION CURRICULUM FOR JUNIORS

1. *Essentials of Electrical Drafting as related to Building Construction*

(a) Line work, lettering, types of drawings, revision flags, etc.
(b) Function of draftsmen working with designer and section chief.
(c) Familiarization with electrical equipment.
(d) Familiarization with the other trades' electrical requirements.
(e) Systems encountered in electrical design.
(f) Importance of coordination between trades.
(g) Stages of jobs from inception to completion.
(h) Comparison of commercial, industrial, and residential jobs.
(i) Discussion of plans, risers, details, and specs.
(j) Economics of specific job: inexpensive circuiting, material, etc.
(k) Time allowed on job.
(l) Basic discussion of national and local codes and availability of NBFU pamphlets.
(m) Familiarization with Slocum & Fuller electric symbols and standards.

2. *Branch Circuits*

(a) Circuiting in general.
(b) Choice of switches and receptacles. Ganging.
(c) Number of outlets and/or ballasts on circuit.
(d) Watts per circuit on 15 and 20 amp lighting circuits. (50% circuiting).
(e) Feeding through switch vs feeding direct to ceiling outlet with hot leg.
(f) Multiwire branches; common neutral; 120/208 v; 277/480 v.
(g) Types of wire.
(h) Types of raceway.
(i) Voltage drop of branches in relation to overall system.
(j) Overcurrent protection.

3. *Lighting Systems*

(a) Basic layouts; quartering — any type fixture. Coordinate with diffusers and sprinklers.
(b) Familiarization with fixture types and the various manufacturers.
(c) Technical information sources and cross reference folder.
(d) Basic lighting problems: one incandescent, one fluorescent (to be done during class).
(e) Basic problems encountered in lighting various rooms (Gym, Auditorium, Library, Classroom, Drafting Room, Office, Factory Loft, Manufacturing Area, etc.).
(f) Importance of uplighting.
(g) Basic problems encountered in outdoor, sign, stage, etc., special high lighting, etc.

4. *Communications*

(a) Types of systems — for drafting purposes.
(b) Basic familiarization with following systems:
1. Fire alarm.
2. Public telephone empty conduit.
3. T. V. empty conduit.
4. Intercom telephone.
5. P.A. sound system.
6. Clock and program.
7. Paging and call systems.

5. *Motors and Basic Controls*

(a) Types of motors used in heating, ventilating, air conditioning, and plumbing work.
(b) Starters, controllers, and disconnects — manual vs magnetic starting.
(c) Pushbuttons and pilots.
(d) Schematic wiring diagrams.
(e) Miscellaneous controls and interlocks. P.E. and E.P. switches, thermostats, firestats, etc.
(f) Single phase vs three phase power.

6. *Distribution*

(a) Feeders — voltage drop; carrying capacity; method of run; type of wire and raceway.
(b) Panel boards — lighting; power; distribution; dimmer.
(c) Circuit breaker vs switch and fuse on panel boards.
(d) Dry type transformers: 277/480 v; 120/208 v.
(e) Emergency feeders.

7. *Service*

(a) Size, type, characteristics.
(b) Service switch, pressure switch, or circuit breaker.
(c) Main transformers — size and characteristics; who furnishes, installs, etc.; vault required; primary switchgear.

Fuel cost survey proves coal best for Poinsett Hotel

The Poinsett Hotel, Greenville, S.C., recently decided to increase steam capacity by adding a new boiler in its power plant. At the time, management asked its consultants, The McPherson Company, of Greenville, to analyze costs of all three types of fuel available in that area. On the basis of cost per thousand pounds of steam, the other two fuels proved to cost 25% more than bituminous coal. According to The McPherson Company, "The net result of this study indicated that by continuing with the use of bituminous coal the owners would save on both the initial investment and on operating costs."

For additional case histories on burning coal the modern way or for technical advisory service, write to the address below.

BITUMINOUS COAL INSTITUTE
Southern Building • Washington 5, D. C.

Note to consulting engineers:

Many companies planning a new power plant, or the remodeling of a present one, consult an engineering firm on its design and construction. When you have such a project, our Engineering Department will be glad to assist you in your fuel cost survey with any coal information you may require. In most cases, for the reasons listed below, the use of coal results in substantial savings in increased efficiency and fuel economy through the years.

facts you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems can cut your labor cost to a minimum • Coal is the safest fuel to store and use • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

Report from Sweden

ETIENNE J. GUERIN
CONSULTING ENGINEER CORRESPONDENT

TWENTY COLUMNS of the Stockholm telephone directory list consulting engineers — a large classified listing by local standards. In the same way, Gothenburg, the second largest city, lists eight columns, Malmo, which is the third largest and next door to Denmark, lists six columns. A good proportion of these listings are, however, branch offices of Stockholm headquarters. This is explained by the fact that burgeoning Stockholm is the hub of the country's industrial and creative activity. The city sprawls over numerous islands with a population of more than a million — of the almost seven and a half million in all of Sweden.

Construction projects, new buildings, diggings, and tunnelings may be observed almost everywhere. State and private enterprise compete with each other on an almost equal basis, and it is apparent that everyone with the necessary investment, knowledge, and courage can have a share of this work.

Forging Ahead

An industrial revolution without precedent is taking place in Sweden. From the "dragging," almost backward country it was some 40 to 50 years ago, it has developed into one of the most industrialized nations in Europe, and in several fields is ahead of Germany. The whole nation has been fully conscious of these changes, changes that have benefited everyone as the standard of living has reached an all-time high.

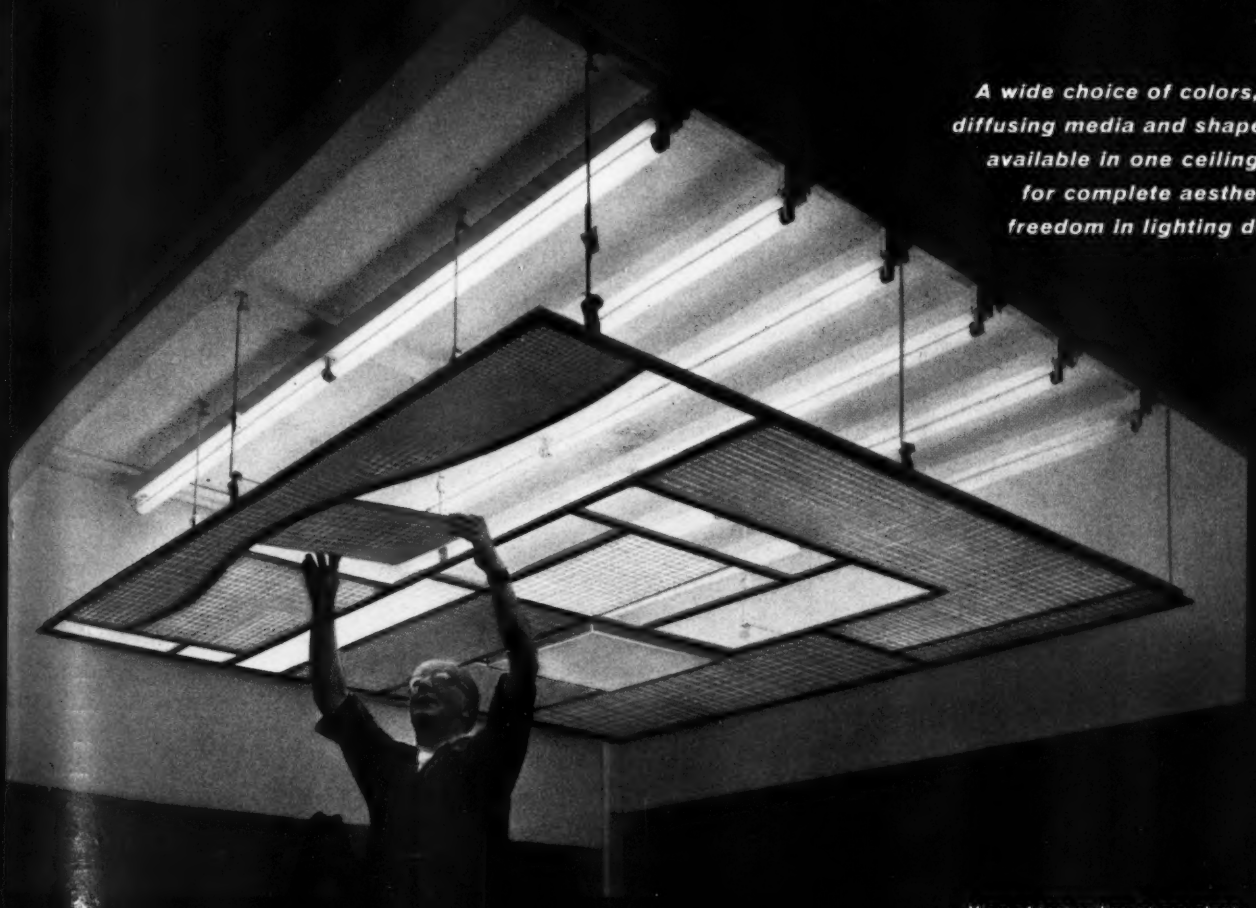
No figures are published regarding the cost of consulting jobs performed by Swedish firms, either in Sweden or abroad, and the firms are not making public any such evaluations. But the total can be estimated to range from 100 to 200 million crowns yearly (1 crown as of March 1, was equal to $0.193). It is likely, however, that such figures, while based on the best estimates, may be misleading.

Consulting Engineer's Association

A sizeable proportion of the Swedish consulting engineers, through the firms which employ them, are members of the Swedish Association of Consulting Engineers, *Svenska Konsulterande Ingeniorers Forening* (SKIF), which was founded in 1910 and is affiliated with the International Federation of Consulting Engineers (FIDIC). However, quite a number of the firms have chosen not to belong to it, one of the reasons most often offered being the high bond deposit of 25,000 crowns (approximately $5000) required by the Association from all its members. But whether they belong to that Association or not, all consulting engineers maintain the same high standards of ethics that are prevalent in most business dealings in Scandinavia. Consulting engineers also belong to other engineering organizations, such as *Svenska Teknologforeningen* (STF), the Swedish Association of Architects and Engineers (by far the largest), or to one of its divisions, such as *Svenska Vag- och vattenbygaares Riksforbund* (SVR), the Swedish Association of Road and Waterfall Builders. STF maintains a large library where more than 400 different publications in all languages

Now! CHOOSE FROM A RAINBOW OF COLOR IN LIGHTING!

A wide choice of colors, diffusing media and shapes available in one ceiling system for complete aesthetic freedom in lighting design



View of test ceiling at our plant.

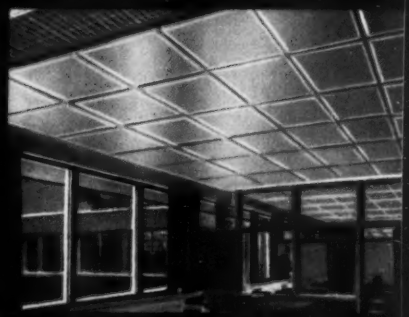
Electro Silv·A·King **LUMENAREA** ceiling system

The simplest, most versatile installation system ever developed!

Here is the world's first large area lighting system that gives you practically unlimited variety of form, as well as color and diffusing media. Now you can design lighting layouts, from the conventional to the abstract, curved or straight in any combination of louver, molded forms, glass and accent lighting . . . in soft pastel pink, blue, green and white . . . in a ceiling completely free of any visible screws, bolts or mechanical devices.

And with all that, the new Electro Silv-A-King LumenArea System, incorporates Slide Adjustment and Adjusto-Lok hanging devices which adjust for spacing and depth *without tools!*

Design of our Overlap Polycube® Louver (1½" cube), on 2 ft. wide modules eliminates the necessity for crossbars, regardless of how long the run . . . also provides 45° x 45° shielding for optimum seeing comfort.



Dished plexiglas ceiling with perimeter of green "Polycube" Louvers helps give this office a distinctive appearance.

For your Free Specification and Data Bulletin, write to

Electro Silv-A-King Corporation, 1535 SO. PAULINA ST., CHICAGO 8, ILL. • SPRUCE & WATER STS., READING, PA.

and from all corners of the earth may be consulted.

Some employee engineers—engineers in government, in industry, or in education—welcome consulting jobs that they can do in their spare time to increase their income. There are many of these part-time consultants in Sweden, and they fulfill a need and offer a service that architects and contractors like to use. Their contribution represents perhaps 5 to 10 percent of the total amount of money spent for consulting work, but figures alone cannot always portray the complete picture.

Consulting engineer Sten Lindberg, who does not actually exist under that name, is typical of the part-time consultant. He studied engineering for four years at the Royal Technical University, *Tekniska Hogskolan* (KTH), the best engineering school in Sweden. Some of his friends were educated at the Chalmers Technica University, in Gothenburg, whic is the second largest engineerin institution.

For the past 10 years he ha had a government position, bu ever since he started his ap prenticeship in a consulting firm he has made lasting acquaintance who now contact him whenever they need advice. He, therefore obtains his home jobs through personal relations.

Typical Income

One of the attractions of Sten Lindberg's government position is that at the age 65 he will receive a pension amounting to 2/3 of his present salary. Taxes are high in Sweden, and on his yearly income of 30 to 35,000 crowns ($6000 to $7000) he has to pay to the government about 12,000 crowns ($2400), after deducting the allowance for his children. While his home jobs will take much of his spare time, he welcomes the 5 to 10,000 crowns ($1000 to $2000) additional that he makes. He keeps half of this money since he is taxed 50 percent on income in addition to his regular salary. These amounts are approximate only, and may vary from year to year.

For what reasons are jobs given to him rather than to the regular consulting firms?

"I am willing to take small jobs, and can do them at once," says Mr. Lindberg, "and beside this, if they are rush jobs, I can have friends help me while the large firms cannot do that." Then to complete the picture, he adds, "I do these jobs myself, while the large firms often delegate small undertakings to junior partners, depending on the job's value. I follow every detail, and in fact, can devote more personal attention to them than can the larger firms."

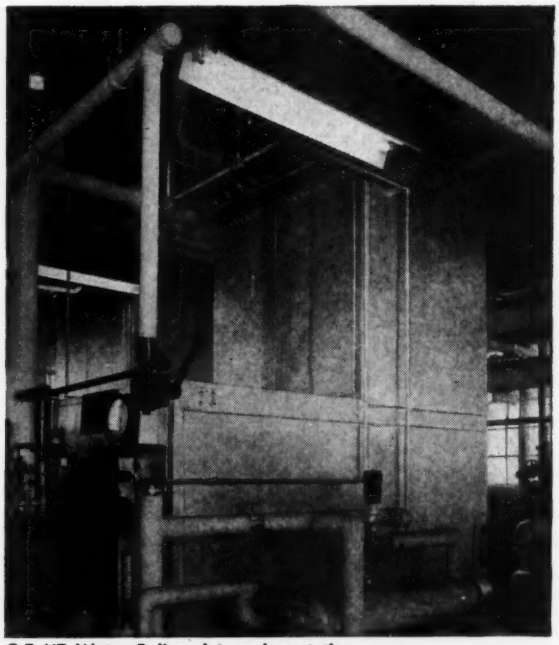
The way in which his fee is fixed by Mr. Lindberg was the subject of another question. "My fees are the same as would be those of an established firm—

The Cross Company specifies . . .

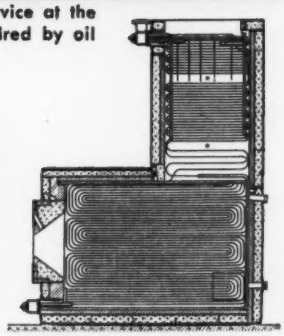
High temperature water by C-E for heating economy ...low maintenance

The Cross Company, pioneer producer of automation machinery, has recently completed an ultra-modern plant in Fraser, Michigan — practically doubling its former production capacity. After a thorough study of heating requirements . . . and with a view toward further expansion . . . two C-E LaMont Controlled Circulation Hot Water Boilers were specified for the new plant. According to Mr. W. P. Reece, Plant Engineer, "the study indicated that this system would provide the lowest fuel and maintenance costs . . . Experience during this winter confirms the soundness of our decision."

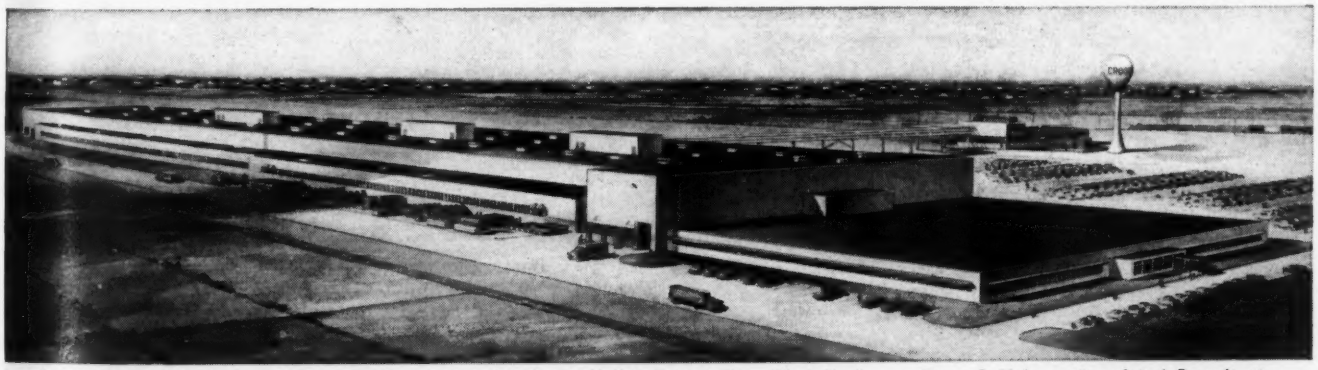
If you are in the market for a heating or process system, it will pay you, too, to investigate high temperature water. Individual needs vary, of course, and both hot water and steam boilers have their place. Our engineers will be pleased to discuss the subject with you or your consultants. Write for our catalog HCC-2.



C E HT Water Boilers in service at the Cross Company. They are fired by oil or natural gas.



Right — One of the 12 million Btu/hr Cross Company boilers. C-E HT Water Boilers are available in sizes from 10- to 300-million Btu per hour; pressures to 500 psi and temperatures to 470F.



Architect's drawing of the new Cross Company plant, Giffels and Vallet, Detroit, Consulting Engineers; Owen S. Lieberg, Associated Consultant.

THESE ARE THE GENERAL ADVANTAGES OF HIGH TEMPERATURE WATER:

1. Higher available heat — many times that of steam at the same pressure.
2. Closer control of temperature.
3. Lower heat loss . . . unused heat returns to the boiler . . . no condensate return lines.
4. No elaborate feedwater treatment . . . make-up requirements are exceptionally low.
5. Steam traps not required . . . trap problems and expense are eliminated.
6. No blowdown losses . . . no safety valve vent losses . . . no condensate losses.

THESE ARE THE SPECIFIC ADVANTAGES OF THE C-E "HT" WATER BOILER:

1. Complete control over circulation in both system and boiler.
2. No separate boiler pump is required, since low pressure loss is inherent.
3. Pressurized operation with oil or gas means no induced draft fan.
4. Single-pass design — no baffles — means cleaner boiler and lower draft loss.
5. Controlled, positive circulation permits more efficient arrangement of heating surfaces.
6. Any fuel — oil, gas, coal, or any combination of fuels.
7. Gastight, welded, steel casing.
8. Fewer headers, all of which are easily accessible.

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ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

about ½ to 1 percent of the project value. I apply the rates listed by the Engineering Association to which I belong."

Sources of Work

The projects submitted to Mr. Lindberg may be from an architect. Or, because of his official position, he may be entrusted with jobs connected with defense installations. Defense spending in Sweden represents 22 percent of the budget, or about 2.7 billion crowns ($540 million). However, the largest share of the spending goes to civil projects, with an allotment of 3 billion crowns ($600 million).

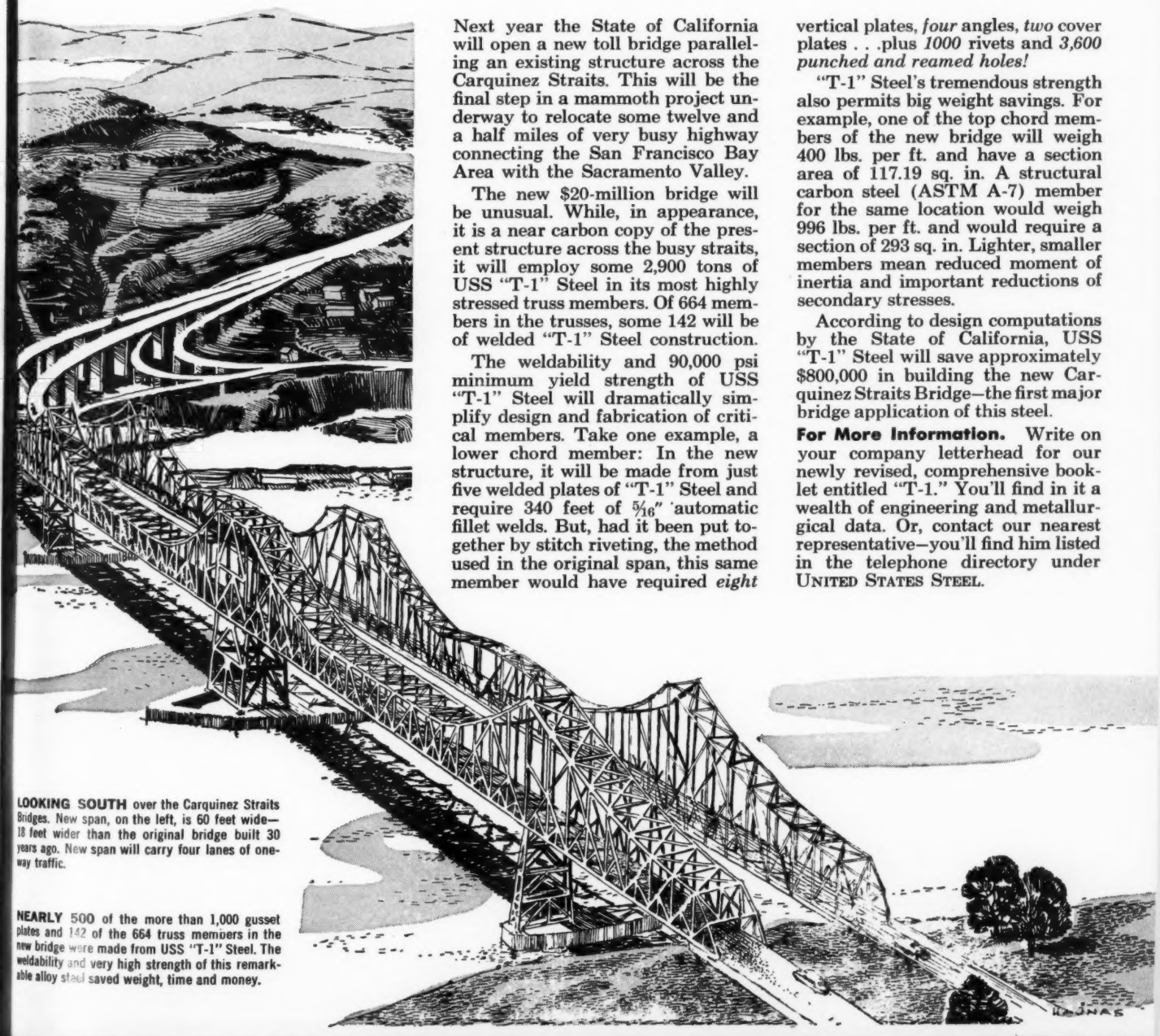
Sweden has developed a new concept of protection from attack that involves digging of "bergrums" or "mountain rooms" in mountainsides and underground. These installations are first surveyed by engineers employed by the government. So, although consulting engineering firms are seldom used for these jobs, some of these government engineers may obtain home jobs on these projects. Some of the work done by private company, AB Atomenergi, for its first atomic reactor, went to engineers in private practice and some to home workers.

Sten Lindberg and all the other part-time consultants in Sweden are indeed needed. They do not seem to take away from the well-established firms business they really want.

It also should be understood that Sweden is beginning to feel a shortage of engineers. For a time, engineers from the Baltic countries—Latvia, Lithuania, and Estonia — filled part of the gap. But as they gain experience and become better known, they accept offers tendered by other countries offering higher salaries.

In a country where engineers are short, all consulting engineers, whether working from a birch-panelled office, or from a private home, offer a valuable service that is needed in order to work toward the progress of Sweden ▲▲

USS "T-1" STEEL WILL SAVE $800,000 IN FIRST MAJOR BRIDGE APPLICATION



LOOKING SOUTH over the Carquinez Straits Bridges. New span, on the left, is 60 feet wide—18 feet wider than the original bridge built 30 years ago. New span will carry four lanes of one-way traffic.

NEARLY 500 of the more than 1,000 gusset plates and 142 of the 664 truss members in the new bridge were made from USS "T-1" Steel. The weldability and very high strength of this remarkable alloy steel saved weight, time and money.

Next year the State of California will open a new toll bridge paralleling an existing structure across the Carquinez Straits. This will be the final step in a mammoth project underway to relocate some twelve and a half miles of very busy highway connecting the San Francisco Bay Area with the Sacramento Valley.

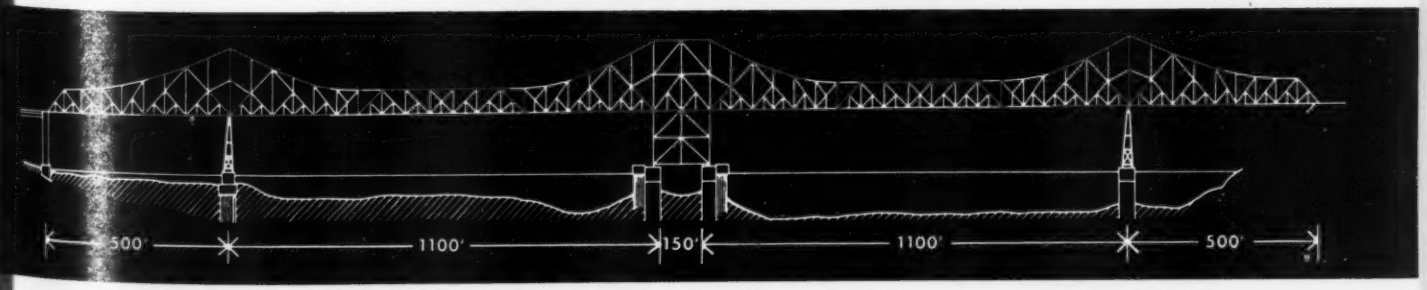
The new $20-million bridge will be unusual. While, in appearance, it is a near carbon copy of the present structure across the busy straits, it will employ some 2,900 tons of USS "T-1" Steel in its most highly stressed truss members. Of 664 members in the trusses, some 142 will be of welded "T-1" Steel construction.

The weldability and 90,000 psi minimum yield strength of USS "T-1" Steel will dramatically simplify design and fabrication of critical members. Take one example, a lower chord member: In the new structure, it will be made from just five welded plates of "T-1" Steel and require 340 feet of $\frac{5}{16}$" automatic fillet welds. But, had it been put together by stitch riveting, the method used in the original span, this same member would have required *eight* vertical plates, *four* angles, *two* cover plates . . .plus *1000* rivets and *3,600 punched and reamed holes!*

"T-1" Steel's tremendous strength also permits big weight savings. For example, one of the top chord members of the new bridge will weigh 400 lbs. per ft. and have a section area of 117.19 sq. in. A structural carbon steel (ASTM A-7) member for the same location would weigh 996 lbs. per ft. and would require a section of 293 sq. in. Lighter, smaller members mean reduced moment of inertia and important reductions of secondary stresses.

According to design computations by the State of California, USS "T-1" Steel will save approximately $800,000 in building the new Carquinez Straits Bridge—the first major bridge application of this steel.

For More Information. Write on your company letterhead for our newly revised, comprehensive booklet entitled "T-1." You'll find in it a wealth of engineering and metallurgical data. Or, contact our nearest representative—you'll find him listed in the telephone directory under UNITED STATES STEEL.



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USS "T-1" CONSTRUCTIONAL ALLOY STEEL

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UNITED STATES STEEL

Notes From Abroad

Fog-Free Engine for Arctic

A device that promises to eliminate the man-made fog of the Arctic, caused by engine exhaust fumes, has been developed by Armour Research Foundation of Illinois Institute of Technology. It is a fog-free engine reported by the Army, following field tests in Arctic regions, as a definite advance in solving the fog problem.

Scientists found that the ice fog resulted mainly from exhaust of internal combustion engines and flue gases from power plant chimneys — both discharging large quantities of water vapor. Passed into the cold atmosphere, the vapor condenses into a wide range of translucent, irregularly-shaped particles that cut visibility through a complicated system of light scattering, diffusion, and transmission, varying with size and concentration of particles.

Using standards that involved the relationship of visibility to exhaust and temperature, the scientists developed an "eliminator" unit based on cooling and condensing, mixing, then reheating the exhaust so that it is passed off with a moisture content below that required for producing the ice fog.

Of importance in establishing the visibility relationship was the development of an electronic fog meter that automatically measures comparative results of light transmitted through and scattered by the fog.

The meter, which should prove useful for other applications, provided accurate comparisons and eliminated lengthy, tedious microscopic counting and sizing of the ice particles.

In the Foundation's working model of the fog eliminator, the exhaust was cooled and condensed to 40 F. It was then mixed with counter-heated air at a ratio of approximately 15 to 1. The resulting gases were mixed again by using the fan of the air-cooled engine and then reheated by an engine cylinder.

West German Engineer Shortage

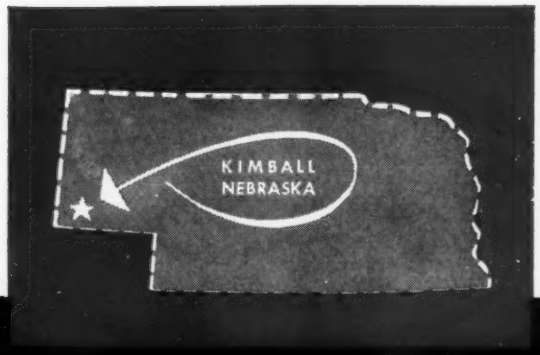
More than 32,000 additional engineers are needed for the electrical engineering and machine building industries in the German Federal Republic, according to a survey made by the technical education division of the Bavarian Government. The number of employed engineers at present is 264,417, of whom 74,741 are certified engineers.

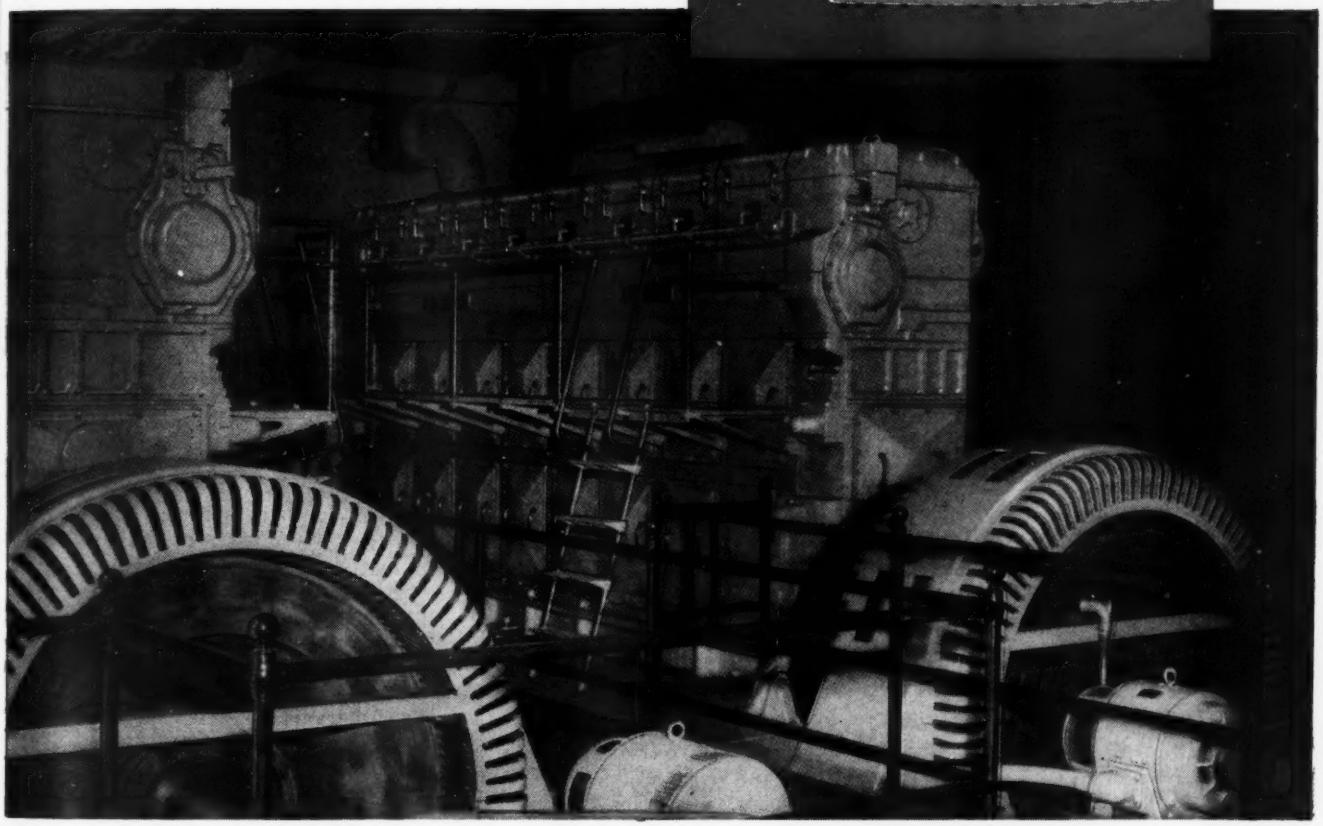
From Swamp to Farmland

The Huleh Valley, which lies in the northeast corner of Israel, covers about 45,000 acres of what was once one of the worst malarial swamps in the region, before the Israeli reclamation project started in 1950. In the Huleh basin the Masbani, Leddan, and Banias streams merge to form the River Jordan. The southern part of the valley was covered by a 7000-acre marsh and the shallow, muddy 3500-acre Lake Huleh.

First phase of the project was widening and deepening of the Jordan south of Lake Huleh, lowering the lake's level. The second stage involved the digging of three major canals, totalling 22 miles in length. The final stage called for the extension northward of both

Kimball's power plant saves $58,000 yearly!





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SUPERIOR DUAL-FUEL ENGINES

Six years ago, fast-growing Kimball, Nebraska decided to modernize its inadequate power plant. Today, powered by three Superior Dual-Fuel Engines, Kimball's power plant is saving $58,000 a year over private utility rates. The engines operate with natural gas at an average cost of 6.93 mills per KWH. On diesel fuel alone power costs are 10 mills per KWH, and annual savings would be $35,000.

The first engine paid for itself in savings in less than three years! Repeat orders later demonstrated the confidence of Kimball city fathers in Superior engine quality. As a further bonus, the three engines are expected to give good service for 35 to 40 years, according to the town's Public Works Director.

Such *savings, satisfaction* and long-term *service* are characteristic of White's Superior engines. See how you can participate in "Kimball-type" savings. Call or write the nearest office listed below. Let White's engineers discuss the new features of Superior and Atlas engines, ranging from 100 to 2150 H.P., for power to 1500 KW.

White Diesel

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the eastern and western canals to link with the Jordan and Hasbani rivers; the construction of two bridges over the canal extensions; and the building of a dam across the Jordan to regulate floodwaters.

When the final drainage projects are completed, 200 additional farming units will be established in the area, and about 100 million cubic meters of water, previously lost through evaporation, will be available for irrigation. The drainage accomplished to date has uncovered 2500 acres of peat, valuable as organic fertilizer. The Israel Research Council has developed a method whereby the estimated 70,000 tons of dried papyrus, gathered from the former marshlands, can be utilized for production of cardboard and certain types of paper.

Bombay Power Capacity Upped

Capacity of the Trombay thermal power station, near Bombay, India, will be increased by 62,500 kw with installation of a new turbine generator. A pulverized coal fired boiler will provide steam at 1250 psig and 950 F. The unit also will be equipped to burn oil.

The extension to the plant will be of the semi-outdoor type and will include a circulating water system capable of handling future expansion needs. Since the existing plant is now operating on oil, the consulting engineers on the project, Burns and Roe, Inc., of New York, are designing a coal and ash handling facility for the new unit. Plans are to change over the existing units to coal firing.

To aid in financing the new addition, the World Bank has loaned Tata Hydro-Electric Power Supply Co., Ltd., Andhra Valley Power Supply Co., Ltd., and Tata Power Co., Ltd. $9.8 million. The companies operate three hydro plants in addition to Trombay.

Power for Siberia

Soviet engineers have drawn up a plan to tap the power resources of the Siberian River Yenisei. The 2485-mile long Yenisei flows through central Siberia, discharging some 126 cubic miles of water annually into the Kara Sea. The power station is to be built about

GIANT ANSWER FOR A HARD-TO-HEAT PROBLEM

Your Warren Webster Man holds the answer to comfort heating in problem areas . . . in factories, warehouses, hangars, garages, machine shops. It's the Webster Giant Blower Fan Unit Heater — largest member of the Webster Unit Heater family — and it's backed by Webster's Finest Product, the Warren Webster Man.

Here's uniform, economical, versatile heating and/or ventilating . . . and complete flexibility in size, arrangement and control. Nine sizes, each with one of ten heating elements for steam or hot water, assure exactly the right unit for every need. Up to 28,000 c.f.m. of heated air, at relatively low final temperatures, are discharged at velocities up to 3400 f.p.m. for rapid diffusion, reduced stratification. Mounting may be floor, horizontal-suspended, wall, or inverted. Ask your Warren Webster Man for Bulletin W-135. Or write us.

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Webster's Finest Product . . . the Warren Webster Man

WARREN WEBSTER

HEATING . . . COOLING

17 miles below the mouth of the Angara River, towards the town of Yeniseisk, and is to produce some 6 million kw, or nearly three times the power of the Kuibyshev power station on the Volga. Twenty hydro units with a capacity of 300,000 kw each will make up the installation. A 219-mile long reservoir will be formed close to the station.

A large industrial center, including metallurgical, timber, and other works, is planned for the area. Any surplus power could be fed to the Urals over a 1250-mile high tension transmission line. If the project is approved, construction will start in 1960 or 1961, and be completed in about eight years.

Another major hydro station on the Yenisei will be the Osinovskaya station, with a capacity of 5 million kw. It will be up-river from the mouth of the Podkamennaya Tunguska, but will not be started until the Yeniseisk station is finished.

The Yeniseisk project will include also the Krasnoyarsk station, on which construction is underway, and the Irkutsk and Bratsk stations on the Angara.

Railway Modernization Plan

In contrast to gloomy predictions by U.S. railroads, the French National Railroads (*Societe Nationale des Chemins de Fer Francasis*-SNCF) has announced a new five-year modernization program to provide for an anticipated passenger increase of 10 percent by 1961 and a freight traffic increase of 30 percent. SNCF last year totaled 18.4 billion passenger-miles and a record 31 billion freight-ton-miles.

Trains now are powered by steam, diesel, or electric engines. Experimental trains have been run on pneumatic tires. A test train of electric locomotive and five coaches has traveled 12 miles at 78 mph without any engineer and entirely controlled by electronics from a distant site.

French engineers have created an experimental railroad coach called the "Pendulum," which carries its passengers with something of the gentle sway of a hammock in a light breeze. The coach is placed on a central axis

ἄριστον *

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PLEASE HELP ME— I NEED A NAME!

I'm your new LUMEN-ATIONS friend, from the sunny shores of far-away and long-ago Greece, and I'm a direct descendant of the famous old Diogenes.

After looking *everywhere* for the world's finest incandescent lighting line, I finally found it—at Guth. So I've gone to work as a silent salesman for Guth, and you'll be seeing a lot of me—in national ads, literature, premiums, point of sale material, conventions, in all sales promotion and merchandising campaigns, pointing out the features and qualities of the Guth Brascolite incandescent line.

There's just one thing wrong—I don't have a name! Will you help name me, please? Just send in your suggestions—as many as you wish—to the Guth address below. The senders of the five best names will each receive . . .

φιάλην τοῦ οἴνου

(a bottle of Metaxa, an excellent Greek brandy)

* "THE MOST"

that's my word for the

Guth brascolite

LINE OF INCANDESCENT LIGHTING FIXTURES

Quality is the word for this new Guth Brascolite incandescent fixture line with Alzak aluminum reflectors. Stylish design, sound engineering, efficient function . . . a real boon to the architect, electrical engineer and all who specify lighting.

And here's another terrific working tool—the new Brascolite catalog. Contains *everything* you need to figure any incandescent lighting job. Write today on your letterhead for your complimentary copy.

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that permits it to tilt slightly to right or left as it takes turns at high speed, reducing the sensation of being thrown outwards. The prototype of this car is equipped also with independently wheeled tracks and disc brakes. Tests will be made in collaboration with other European railroad systems under the sponsorship of the International Railroad Union.

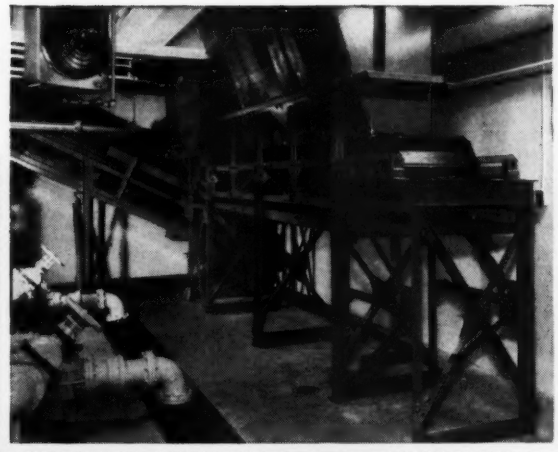
Electric engines run on a-c current through French engineering adaptation of the American ignitron. Rail sections 2600 feet long are welded to reduce noise and improve comfort. "Auto-rails" speed passengers between junctions in super-charged, diesel driven cars. Approximately 3234 miles of the most important rail lines have been electrified, so that today about 40 percent of rail traffic is electrically hauled. On SNCF lines, two types of electric locomotives designed and built in France broke the world's speed record, reaching 206 mph.

This year, electrification will be completed on the lines between Strasbourg and Basle, between Dole and Vallorbe, and between Frasne and Pontarlier. The Nord-Paris project, which will include the Paris-Lille line and several connections toward Valenciennes and main coal centers, will be completed by the end of 1958. A further 930 miles to be electrified under the five-year plan will save an annual 1.2 million tons of coal.

By 1961, 20 percent of the SNCF lines (about 4760 miles) will be electrified. These lines will be carrying from 60 to 65 percent of the total rail traffic.

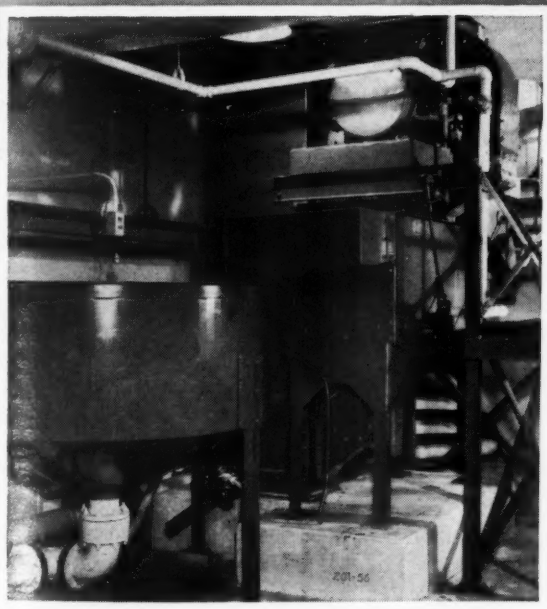
Limited in principle to lines with less traffic on them, diesel engines will be used for special jobs. The number of "Autorails" will be increased to about 1100 and the number of diesel engines and railway motor tractors of 400 to 850 hp used in secondary lines and station shifting will reach 1000 by 1961. The larger 1300 to 1400 hp engines gradually will replace steam engines on certain lines. Locomotives of 2000 hp, similar to those already operating on Paris suburban lines, may be introduced to pull heavy freight trains on some of the non-electric stretches.

Other facets of the five-year



Trucks dump garbage into this hopper. A slow-moving apron conveyor discharges onto the faster-moving apron conveyor, thinning out the material.

This apron conveyor drops the garbage into a Jeffrey Type B grinder. The bucket elevator at the left discharges grit from the washer seen below.



From the grinder the garbage passes into the washer where grit is removed. The organic slurry overflows into the slurry tank and is pumped to the digesters.

JEFFREY

recommends dual garbage-sewage disposal for low operating costs

Garbage can be economically disposed of with sewage solids. Jeffrey sanitation engineers have found that garbage solids can be ground and pumped directly to digesters. Grit is removed first, of course. That is the system illustrated here at the new treatment plant in Kokomo, Indiana.

For help on any treatment plant problem, write to The Jeffrey Manufacturing Company, Columbus 16, Ohio.

JEFFREY

CONVEYING • PROCESSING • MINING EQUIPMENT • TRANSMISSION MACHINERY • CONTRACT MANUFACTURING

plan include an increase in the number of automatic signal blocks and improvement of manual blocks; addition of 1200 more automatic signals at grade crossings; and setting up of an entirely automatic telecommunication system.

Electrification of USSR Railways

In 1956 some 621 miles of railway lines in the USSR were electrified, and by 1960 another 5000 miles are to be converted. Plans are underway to convert the 3100-mile Moscow-Irukutsk line, the Moscow-Kharkov-Donbas line, and other major rail connections in industrial sections.

Last year saw the introduction, for the first time in the USSR, of a-c electric traction at 22,000 v on a 84-mile sector near Moscow. The 1957 plan provides for electrification of about 750 miles of track. Electrification of the Omsk railway has lowered transport costs, increased efficiency by 72 percent, and released 2500 men for work in other industries.

Designed for Newest Planes

When completed in 1959, the new International Airport near Ciudad Trujillo, Dominican Republic, will be capable of providing non-stop service to New York 2000 miles northward, or to Rio de Janeiro some 3000 miles to the south. The airport, to cost in excess of $9 million, is being built by *Concretara Dominicana C. por A.*, of Ciudad Trujillo, with major engineering services being performed by Rader and Associates, of Miami, Fla.

The airport will be able to receive aircraft with the heaviest wheel loads envisioned for the next 20 years. There will be a complete fueling system for all types of planes, including jet transports. The airport will be geared to handle 40 operations per hour, and will include the most modern terminal building in the Caribbean.

Rader and Associates hold the engineering contract for the design, plans, specifications, and material lists for the actual execution of all electrical, mechanical, and communications facilities. These include water supply, sewage disposal, building plumbing and air

Acme FLOW-THERM® with CERTIFIED DEPENDABILITY

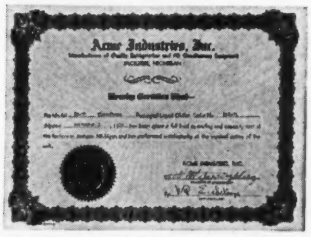
Acme's new DD Series Flow-Therm Liquid Chillers combine the advantages of close-coupled direct drive between compressor and motor with new engineering features that make these units the most advanced large-tonnage packages on the market today. Completely enclosed, tamper-proofed control panel with pilot lights to warn of open limit switches . . . Pilot-operated regulator valves for smooth, accurate refrigerant control and increased capacity range at low superheats . . . these and many other features are worth your investigation.

TEST CERTIFIED

In addition to the normal factory tests for leaks and mechanical defects, all Acme packaged chillers are tested under full load conditions before leaving the factory. Every unit must perform satisfactorily at its nominal rating. Your guarantee of this tested operation is the new Acme Certificate of Performance, a "first" in the industry.

NINE MODELS – 20 THRU 125 TONS

With Acme you get a more complete range of models, with capacities to fit exact job requirements. This is possible because the Flow-Therm's chief components, famous Dry-Ex Chiller and Shell-and-Tube Condenser, can be tailor-made to match compressor performance exactly — combine operating economy with maximum capacity.



Acme Certificate of Performance issued on all Flow-Therm and Flow-Cold packaged liquid chillers, 3 through 125 tons.

To Get Your Copy of Acme's data-packed Flow-Therm catalog, just send us this coupon attached to your letterhead

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Dry-Ex Liquid Chillers


Liquid Receivers


Heat Exchangers


Condensers


Packaged Chillers


Packaged Heat Pumps


Evaporative Condensers & Cooling Towers


Room Conditioners

Manufacturers of Quality Air Conditioning and Refrigeration Equipment since 1919

conditioning, the compressed air systems, runway lighting, street and parking area lighting, radio facilities for communications, navigation and traffic, public address, and intercommunications.

Operation Hazen

Led by Dr. Geoffrey Hattersley-Smith, 34-year-old Defense Research Board glaciologist, a group of eight scientists began the first of a three-phase geophysical, geological, and climatological study of the Lake Hazen area in north Ellesmere Island, Canada's northern most land mass, early in May, in support of the International Geophysical Year program.

During phase one of "Operation Hazen," Dr. Hattersley-Smith and his associates were airlifted to Lake Hazen by the RCAF to establish a base in the vicinity of Johns Island. The party will organize an advance camp on the nearby ice cap for geophysical, glaciological, and meteorological studies.

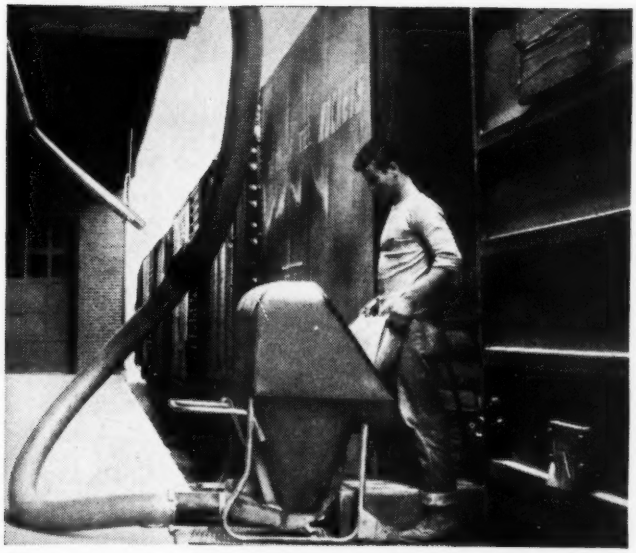
Phase two will include the establishment of a winter site to obtain synoptic or general meteorological observations and to study the thermal regime of the lake over a 12-month period.

Plans for the third and final phase during 1958 will depend in size and scope on the results obtained this year. Scientific personnel may be added to the party to extend the 1957 work and to undertake biological studies.

The Royal Canadian Air Force and the United States Coastguard will support the expedition with air and sea transport and the Canadian Army is providing oversnow vehicles and cold weather equipment. About 100 lbs of dehydrated meat, prepared by a process developed recently at the Defense Research Medical Laboratories at Downsview, Ontario, will be tested.

About 70,000 lbs of summer and winter supplies will be required to support the operation for a six-month period. Nearly 13,000 lbs had been airlifted to the ice cap by RCAF ski-wheel aircraft from Resolute Bay, in May.

While studying the shelf ice bordering the north Ellesmere Island coast on two previous oc-



Let's talk pneumatics

FOR IMPROVED MATERIALS HANDLING

In view of continuous expansion in practically every industry to meet the demands of larger markets, the economics of plant design dictate close scrutiny of all available materials handling systems.

When dry bulk and pulverized materials must be brought into the plant and transported through a series of in-plant operations, a totally enclosed pneumatic conveying system often provides an ideal answer to problems of contamination, control of material movement, storage, and freedom from mechanical hazards.

The inherent flexibility of engineered pneumatic conveying systems, used alone, as an integrated space saving materials carrier or in conjunction with other materials handling equipment, offers the consulting engineer greater freedom of plant design or modernization.

Because of this flexibility and because of the good reputation of experienced, able manufacturers of pneumatic conveying equipment, the number of possible solutions to your materials handling problem is increased.

If pneumatic conveying systems will *not* meet your needs as satisfactorily as other methods Fuller, with more than 30 years of engineering and manufacturing experience and a fine reputation to protect, will tell you so.

HOW TO SAVE YOUR TIME AND RE-DESIGNING

Pneumatic conveying systems are designed to fit individual requirements. That's why it is important that the consulting engineer and a reputable manufacturer of pneumatic conveying equipment start early in the project development to select the necessary equipment and design an efficient space-saving system.

HOW TO GET STARTED

1. Remember that successful pneumatic conveying systems require expert engineering assistance.
2. Write for information on systems you will want to consider.
3. Discuss your requirements with a reputable manufacturer while your project is still in the formative stage.

PRODUCTS OF FULLER COMPANY

FULLER-KINYON and FULLER-FLUXO PUMPS for conveying dry pulverized materials • FULLER-KINYON REMOTE-CONTROL UNLOADER for unloading dry pulverized materials from box cars, ships, barges, and flat-bottom storage bins • F-H AIRSLIDE® FLUIDIZING CONVEYOR for fine, dry materials • FULLER AIRSLIDE TRANSFER UNIT • THE AIRVEYOR® for unloading, conveying and reclaiming fine, granular, and crushed materials • FULLER AIRMERGE BLENDING SYSTEM • FULLER ROTARY COMPRESSORS and VACUUM PUMPS • SUTORBILT ROTARY POSITIVE-PRESSURE BLOWERS • GAS PUMPS • VACUUM PUMPS • LEHIGH INDUCED-DRAFT FANS • FULLER PREHEATER Humboldt Suspension Type • FULLER INCLINED-GRATE COOLER • FULLER CLINKER BREAKER • FULLER DRY PULVERIZED-MATERIAL COOLER • FULLER ROTARY FEEDERS and ROTARY VALVES • MATERIAL-LEVEL INDICATORS • MOTION SAFETY SWITCH • AERATION UNITS • SLURRY VALVES •

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casions, Dr. Hattersley-Smith returned to the Defense Research Board headquarters with relics from past historic expenditions dating back to 1876. A particularly interesting find was a remnant of the United States flag carried by the late Admiral Peary, in 1909, when he claimed to have dashed across ice floes to the North Pole from Ellesmere Island.

Surveyors' Instrument

A new instrument has been designed in South Africa that solves the problems a surveyor faces in measuring accurately his base line — the line to which all subsequent measurements are referred. The new instrument provides an electronic method of measuring length. Practical range is about 35 miles, with a minimum of 500 feet. Probable error is one part in 300,000.

Dnieper Power Plan

The Ukrainian branch of the Hydro-Technical Installations Institute has produced a plan known as the Dnieper Cascade that proposes building of 14 hydroelectric power plants on the Dnieper to produce as much as 14.5 billion kwh a year. Construction of the new hydro power stations is expected to increase the power output of the older plants, such as the Dneproges, by regulating the river's flow. The spring floods, though of short duration, account for about three quarters of the Dnieper's annual discharge, while during dry summers the discharge may fall to one hundredth of the volume of spring discharge.

The Dneproges station has a generating capacity of just over 650,000 kw, but because of the station's small reservoir, can only guarantee about 150,000 kw. This problem could be solved by building more reservoirs, but these would take up valuable farming land. The solution seems to be the building of reservoirs in the middle and lower reaches of the river where water could be used to irrigate the arid lands in those areas and meet the need for industrial uses. Most of the arid land is in the lower reaches of the river, along the Black and Azov Seas and in the Crimea. In all, the area

GET SQUARE D SAFETY SWITCHES AND BENEFIT FROM THE NEW NEMA STANDARDS

NEMA standards are adopted in the public interest and are designed to eliminate misunderstandings between the manufacturer and the purchaser, as well as to assist the purchaser in selecting and obtaining the proper product for his particular need.

Square D's quick change to the new standards gives you the performance and safety which NEMA standards assure.

Square D Safety Switches cost no more —why settle for less?

DESCRIPTION	HEAVY DUTY New	NORMAL DUTY formerly Types H, S, or A	LIGHT DUTY formerly Types D or G
Rating-Ampere Voltage	30—600 250 or 600V AC, DC	30—1200 250 or 600V AC, DC	30—200 250V AC
Enclosure	NEMA 12 • Industrial Use (Gasketed) NEMA 4 & 5 • Water-tight & Dust-tight NEMA 7 • Explosion-resisting Class I—Group D NEMA 9 • Explosion-resisting	NEMA 1 • General Purpose NEMA 3R • Raintight	NEMA 1 • General Purpose NEMA 3R • Raintight
Horsepower Rating	NEC Fuse Ratings Dual-Element Fuse Ratings	NEC Fuse Rating Dual-Element Fuse Ratings	NEC Fuse Rating
Operating Mechanism	Quick-Make, Quick-Break Independent of Handle	Quick-Make, Quick-Break Independent of Handle	Positive Make, Positive Break Spring Assisted
Cover	Interlocked & Padlock Attachment	Interlocked & Padlock Attachment	Padlock Attachment
Plating—Current Parts	Extra-Heavy Silver	Silver	
Endurance	Maximum Endurance Far Exceeds UL Standards	Exceeds UL Standards	Meets UL Standards

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SQUARE D COMPANY

to be irrigated amounts to 9 million acres.

This use of water will not affect the working of the power stations since most of it will come from the Kakhovka reservoir, the last one down the river. In addition, water can be brought from Kakhovka along the ship canal into the Krivoi Rog metallurgical center. Regulation of the river will allow seagoing ships to penetrate as far as Kiev, the Ukrainian capital.

Two of the stations are already supplying power: the 650,000-kw Dneproges station and the 312,000-kw Kakhovka station. Work is in progress at the Dneproderzhinsk and Kremenchug stations, with a combined capacity of 800,000 kw.

French Export Brains

Some 450 French experts today are serving as advisors, teachers, and engineers in the development of 54 nations. Examples of engineers serving in other countries, either under auspices of the United Nations, or sent directly by the French government or French private enterprise are:

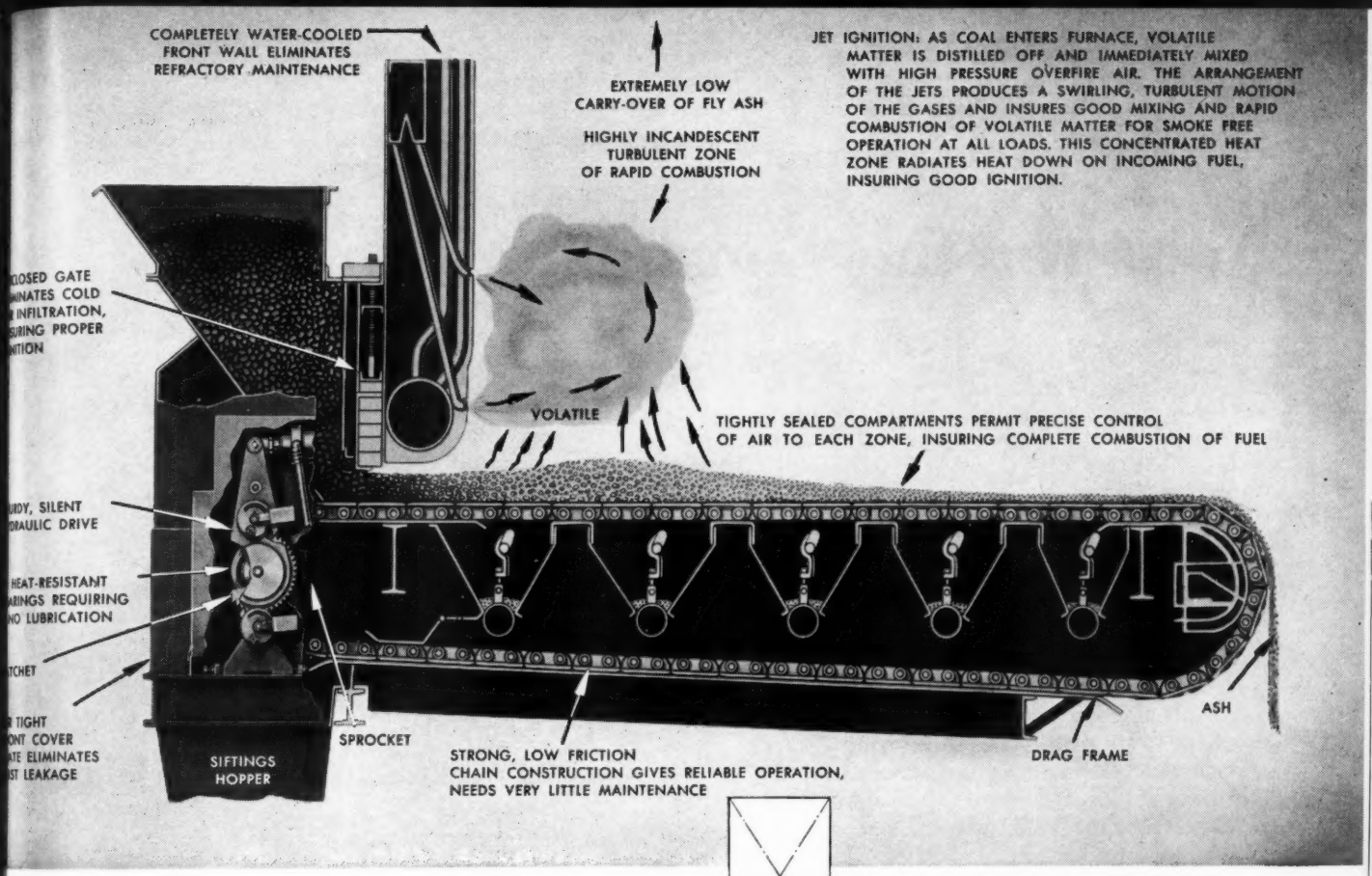
A French consulting enigneer, formerly representing France at the Copenhagen Productivity Center, created an Institute of Technological Research in Central America, founded by multilateral accord among the five republics of the region. He introduced the metric system, created a Bureau of Standards, and popularized use of a process of steeping hemp, perfected by the Pasteur Institute.

In Nicaragua, a Frenchman is setting up the Nation's entire industrialization plan.

In Uraguay, all professional training is supervised by a Frenchman, and in Ethiopia, the Chief Engineer is French.

A French engineer studied the ports of Iran and his recommendations allowed construction companies to proceed with work on the ports nine months sooner than was expected.

Other French engineers are carrying out such projects as plans for new airports at Damascus and Aleppo, Syria; plans for irrigation of areas of Pakistan; and mining exploration in Nepal. ▲▲



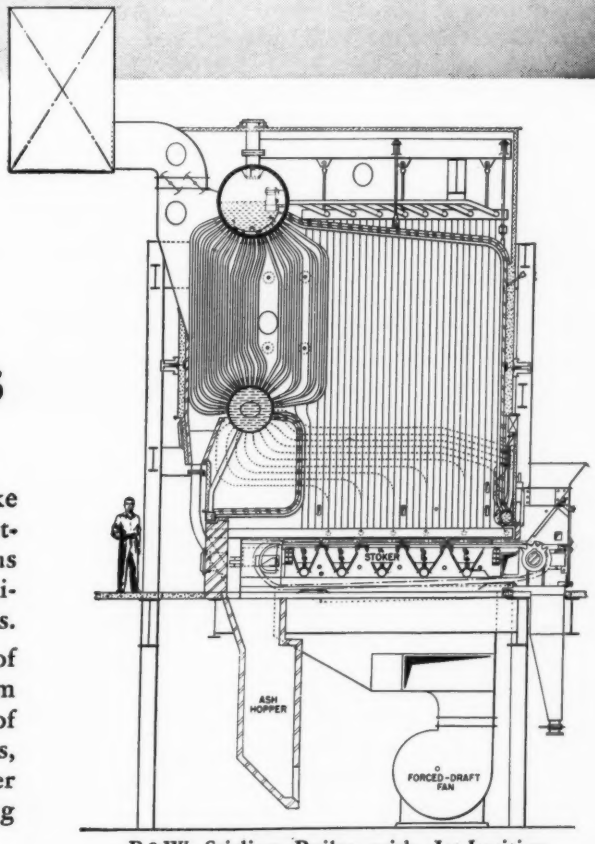
Latest Unit at University of Rochester Will Burn High-Caking Coals

B&W JET-IGNITION STOKER SELECTED TO SOLVE SMOKE AND FLY ASH PROBLEMS

Stable, efficient combustion over wide load ranges, without smoke and with extremely low fly ash, is achieved by the new B&W Jet-Ignition Stoker when burning bituminous and sub-bituminous coals—including high-caking and coking grades. The Jet-Ignition Stoker maintains a clean stack without using dust collectors.

Selection of a B&W Jet-Ignition Stoker for the University of Rochester was made to solve a community relations problem caused by smoke and fly ash. Dr. Lewis D. Conta, Chairman of the University's Division of Engineering, and George D. Haas, Chief Engineer, recommended installation of the unit after observing a commercial installation burning the high-caking coals used by the University.

B&W Jet-Ignition Stokers are another of the developments of B&W engineering and research, supported by nearly a century of experience in all phases of steam generation. If your problem is one of excessive smoking and fly ash emission, Bulletin G-85 will tell you how a B&W Jet-Ignition Stoker can help you. And for any problem in steam generation, B&W engineers are ready to help you and your engineers find the solution. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.



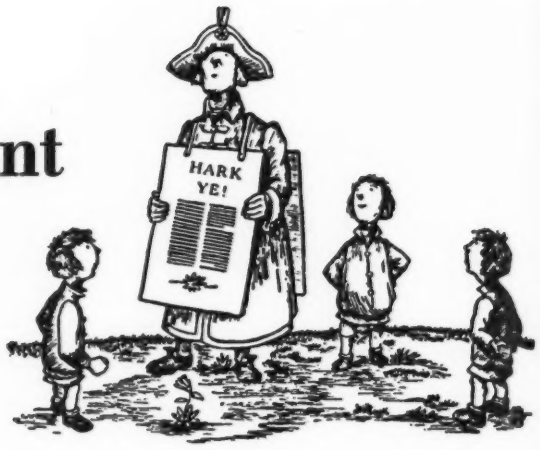
B&W Stirling Boiler with Jet-Ignition Stoker at University of Rochester, designed for 100,000 lb of steam per hr at 125 psi.

G-831-1B

BABCOCK & WILCOX

BOILER DIVISION

News for the Consultant



Maryland Engineers Form CE Association

The Consulting Engineers Council of Maryland was formed at an organizational meeting in Baltimore, attended by representatives of 29 consulting engineer firms with offices in the state.

A Constitution and By-laws were adopted and the following officers elected: president, William R. Kahl, of Rummel, Klepper & Kahl; vice president, William G. Robertson, Jr., of Henry Adams, Inc.; secretary, A. Russell Vollmer, of Whitman, Requardt & Associates; and treasurer, Robert E. McNeill, of McNeill & Baldwin.

Directors are: Robert G. Deitrich, of J. L. Faisant & Associates; W. Worthington Ewell, of Ewell, Nelson & Bomhardt; and Arthur M. Gompf, of Egli & Gompf, Inc.

The organization is a result of the combined efforts of representatives acting on informal committees appointed by temporary chairman Kahl at the initial meeting of the group in November of 1956.

NSPE Reports on Engineer Employees Of Consulting Firms

A nation-wide survey of the status of engineers employed by consulting engineering firms has been published as a 40-page report by the National Society of Professional Engineers. The report, "Engineers Employed by Private Practitioners," contains basic information on salaries, hours, geographic distribution of engineer employees, size of the firm, fringe benefits, length of work-week, and overtime pay practices.

The 311 consulting firms surveyed ranged in size from those with one engineer employee to those with as many as 300. The total number of employees represented is 6407. The average number of employees for all the firms is 20.6, but data have been analyzed by size of firm to eliminate undue weight to the very large firms.

Median salaries summarized in the report are based on the eight grades of NSPE's "Recommended Grades, Duties, Responsibilities, and Qualifications for Pre-Professional and Professional Positions." The most popular fringe benefits listed in the report are paid vacations, bonuses, hospitalization insurance, life insurance, and profit sharing. Standard work-week of most firms is 40 hours, but 5.8 percent work less than 40 hours, and 28 percent work 41 to 44 hours.

One of the interesting facts brought out by the survey is the fact that only 40.9 percent of the engineering employees are registered professional engineers, and only 8 percent are registered as engineers-in-training.

The survey was a research project undertaken by the Engineers-in-Employ-of-Practitioners Subcommittee of the Employment Practices Committee. Next step will be analysis of the findings and the development of programs to meet the needs of the engineering employees in their professional and economic advancement.

Copies of the report may be obtained for $1 each (50¢ to NSPE members) from NSPE, 2029 K Street, N.W., Washington 6, D.C.

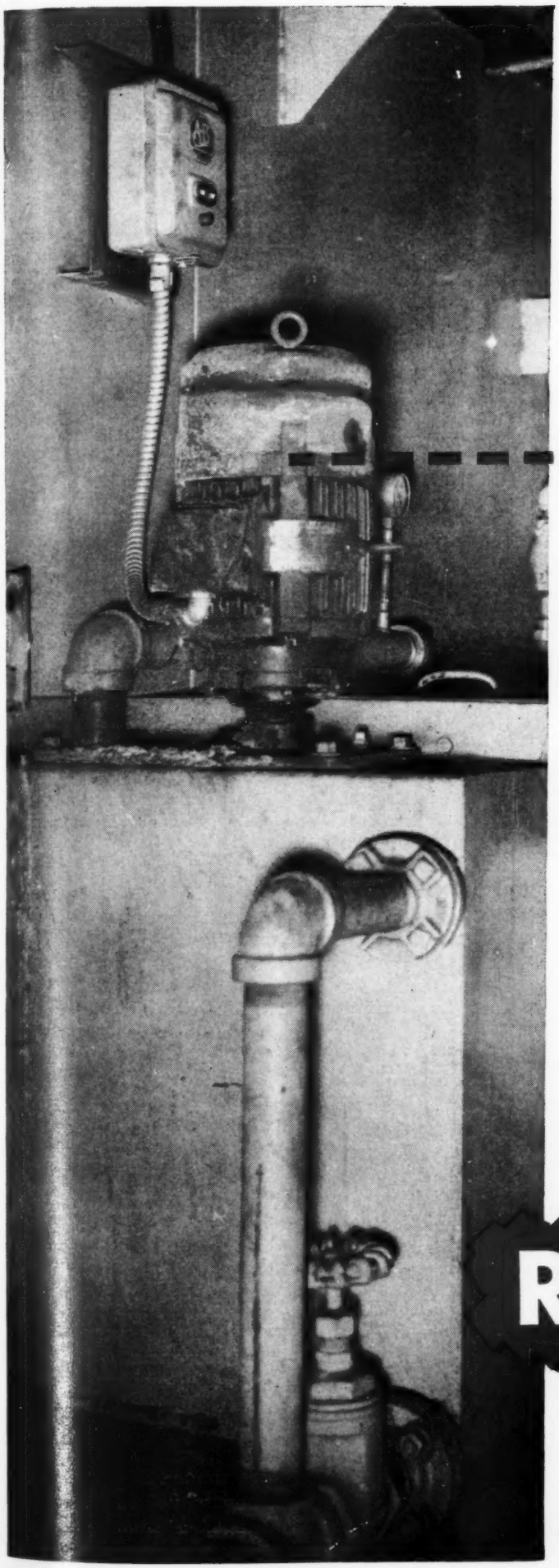
So We Took a Survey, and . . .

Results of a survey conducted by the National Constructors Association among member companies engaged in engineering and construction of chemical plants, petroleum refineries, steel mills, and power plants showed a growing interest in aids to education as a means of combating the shortage of engineers, draftsmen, and technicians.

Of the twenty firms replying — varying in size from employers of 1500 to 100 engineers — all reported some type of program in the field of education, ranging from direct grants to local programs involving teachers, students, and employees.

Some 85 percent reported using high school teachers, college professors, or instructors on a part-time basis. About 65 percent indicated that members of their engineering and technical staffs serve as instructors on a part-time basis.

Financial assistance to employees studying engineering or drafting were provided by 70 percent, with



RELIANCE solves motor corrosion problem

This Reliance Corrosion-Proof Motor is operating a pump which circulates cleaning solution through a tank containing metal parts. The motor is subjected to corrosive vapors and liquids each time a basket of parts is removed. BUT THIS MOTOR WILL NOT CORRODE.

The solid cast-iron housing, including the fan cover, will withstand corrosive service indefinitely. Wiring identification is preserved on a stainless steel name plate. A threaded outlet is provided on the water tight conduit box, and motor leads are molded into a neoprene gasket that completely seals off the windings from the conduit box. A neoprene or non-ferrous shaft slinger seals the only other frame opening.

These and many other features give you a motor with a built-in corrosion protection. Why not install this superior design now and save many replacement dollars in the years ahead.

Write for bulletin B-2406 for complete design details.

D-1634

Zone 17, 337A

RELIANCE ELECTRIC AND ENGINEERING CO.

DEPT. 337A, CLEVELAND 17, OHIO
CANADIAN DIVISION: WELLAND, ONTARIO

Sales Offices and Distributors in Principal Cities

65 percent providing training of this type within their own organization.

An interesting sidelight to the ever increasing number of surveys designed to show how to combat the engineering shortage is a study conducted by Max A. Pape, a consultant to the Del Wakeman Co., San Francisco, as reported in *Aviation Week*.

Using backgrounds, names, and addresses of three working engineers and two engineering students, Pape answered 30 magazine and 75 newspaper ads for engineers. Seventeen of the resumes were never acknowledged. Twelve were answered with form letters, some not signed and some not even personalized by the filling in of the applicant's name.

Only 23 of the 76 replying answered a specific question asked in each application. The other 53 merely sent application blanks.

Of the 50 application blanks Pape completed and returned only 13 were acknowledged. Three companies asked engineers with five years' experience to take aptitude tests. Of 31 job offers, two disapproved of the undergraduate school attended and one questioned the standards of the graduate school.

From the results of the study, *Aviation Week* concluded that there is no actual shortage of engineers.

Where to Park Those Cars

Engineering studies made by Frank Grad & Sons, of Newark, N. J., indicate that construction of three-level underground parking facilities beneath Newark's Military Park would be feasible from an engineering viewpoint. The next step will be to evaluate economic demand studies being made by Ramp Buildings Corp. of New York. This report will determine the optimum size of the garage.

Immediately thereafter, completed preliminary design, cost analysis, and operations and income forecasts can be made so that the economic and engineering feasibility studies can be studied jointly.

The studies are being financed under an interest-free federal loan of $180,000. The loan must be repaid only if the garage is built.

A proposal for construction of an underground parking garage beneath the Cleveland Mall was revived when the H. K. Ferguson Co. was asked to complete detailed plans for the project. The garage will cost some $4½ million and will take approximately 18 months to build.

It is hoped that the garage can be built by private capital under a lease agreement. The city would get rent and eventually would obtain title to the structure when the lease ran out in a 40-year or other long-term period.

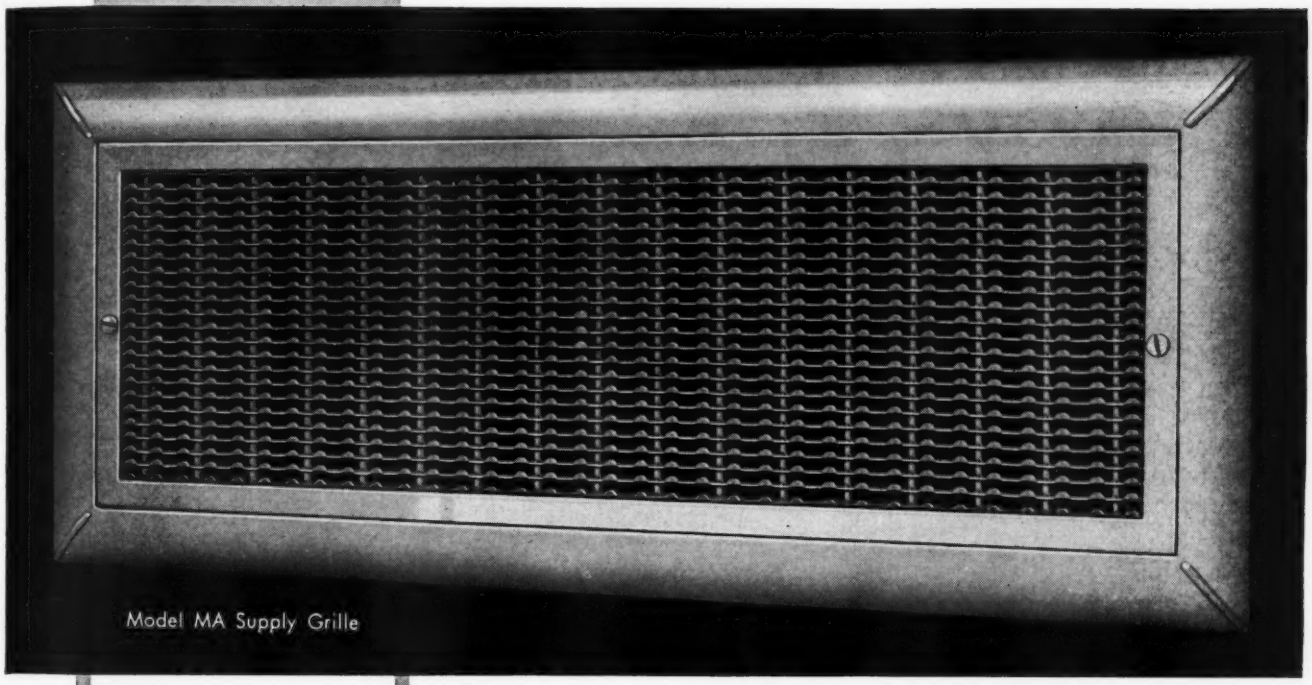
Milwaukee's main downtown business area still will have a deficiency of about 6000 parking spaces when four municipal parking pavilions are completed, according to a report submitted to the City Parking Commission by Martin E. Bruening, superintendent of the City Bureau of Traffic Engineering and Electrical Services. No recommendations were made by Bruening in submitting the report, which will be used to help the city select parking sites.

THE MARK OF QUALITY

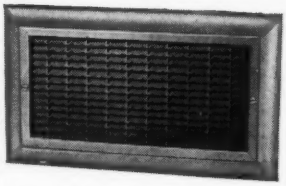
BARBER COLMAN

Uni-Flo Grilles

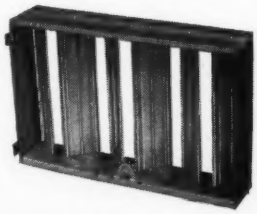
make air behave



Model MA Supply Grille



Model MF Return Grilles match the MA Supply Grille, above. A variety of frame styles in a complete line of both supply and return grilles provides continuity of appearance.



Opposed-blade volume control with gang-operated blades provides efficient, nondirectional control of air flow — easy adjustment.

Uni-Flo Grilles coupled with published data from the widely recognized Uni-Flo Laboratory eliminate guesswork. Performance guaranteed when used according to these data. Uniform comfort maintained throughout occupancy space, even with temperature differentials up to 25° F. Air pattern easily adjustable after installation.

Key-operated opposed-blade volume control available for easy system balancing. Key operation resists unauthorized adjustment. Removable, adjustable core and wide variety of frame styles meet various architectural requirements. Tamper-resistant design ideal for use in institutions.

And remember . . . only Barber-Colman combines skills in both air distribution and automatic temperature controls for *undivided* responsibility.

NEW CATALOG — write for new complete grille catalog. Fully illustrated with photos, line drawings, and installation detail drawings. Sample specifications.

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In a subsequent development, Earl W. May, chairman of the Milwaukee Land Commission and a consulting engineer, suggested that several parking pavilions be constructed over the Milwaukee River in the downtown business district. He said such structures, with a capacity of at least 5000 cars, could be built on piles sunk in the river bed.

"Engineer-wise, this is feasible," May said. "I am quite sure they wouldn't cost any more than regular structures, because we would get the 'land' free."

May said he would present his suggestion in detail to the Land Commission staff and to the City Parking Commission for study.

Herbert Moore, another Milwaukee consulting engineer, offered a similar plan to the city several years ago, but it was regarded at the time as not economically sound.

Los Angeles Sewerage Project Making Rapid Progress

Los Angeles, Calif., will nearly double the capacity of its sewage disposal facilities when the $60 million Hyperion project is completed. The capacity will be increased from 245 mgd to 420 mgd, the average flow today being 255 mgd. About $19.3 million is to be used for local sewers, and $40.7 million for a new outfall sewer and final disposal facilities. This latter work is being done by Hyperion Engineers, which is a joint venture among three Los Angeles engineering firms; Holmes and Narver, Inc.; Daniel, Mann, Johnson and Mendenhall; and Koebig and Koebig, Inc. The work includes $14 million for the North Central Outfall Sewer, $3 million for an Ocean outfall for digested sludge, $16 million for an Ocean outfall for effluent, and $7.7 million for additional facilities at the Hyperion Treatment Plant. David L. Narver, Jr., is project manager for Hyperion Engineers.

The basic plan is to modify the treatment provided at Hyperion so that an average flow of 300 mgd of sewage will receive primary sedimentation only before being discharged to sea. Another 120 mgd of sewage will receive conventional activated sludge treatment in the existing aeration and final settling tanks and will then be either discharged to sea or reclaimed as industrial or ground recharging water. The combined effluent will be pumped through a 5-mile long, 12-ft diameter ocean outfall extending to a depth of 194 feet. Sludge produced by the treatment process will be digested and then pumped through a 7-mile long ocean outfall to be discharged at a depth of 300 feet. Existing vacuum filters and sludge dryers will be moth-balled until such time as the production of fertilizer becomes profitable.

The new North Central Outfall, which conveys

Detroit's SHERATON-CADILLAC HOTEL

stays modern with AIRTEMP AIR CONDITIONING

1949—Ballroom air conditioned by Chrysler's Airtemp Division.

1951—First Airtemp cooling added to Parlors and Meeting Rooms.

1954—Modernization of cooling system in Dining Rooms, Bars and Lounges starts with new Airtemp equipment.

1955—500 rooms equipped with Airtemp combination heating and cooling.

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1957—All remaining guest rooms—554—now receiving Airtemp heating and cooling.

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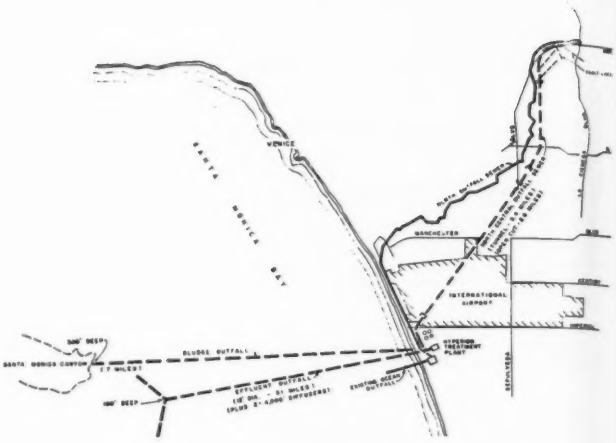
AIR CONDITIONING OR HEATING FOR A ROOM . . . A HOME . . . A BUSINESS . . . AN AUTOMOBILE

sewage from La Cienega Boulevard to the site of the existing Hyperion treatment plant will be completed in May 1958. The sewer is 9½ feet in diameter and 42,000-ft long, about two thirds of which is in a tunnel. Concrete lining of the westerly half of the tunnel was scheduled to start in mid-May, 1957. The contractor for the easterly half is now tunneling and doing open-cut work. It will be protected against corrosion with a vinyl plastic liner. The outfall has two inverted siphons, one of which is approximately 2600-ft long.

The Ocean outfall for sludge discharge is a 7-mile long, 22-in. steel pipe coated on the inside with cement mortar and on the outside with coal tar and gunite. It is provided with cathodic protection of the impressed current type. It is constructed by joining lengths of pipe by welding on the beach, and then pulling them to sea by anchored barges. The contractor scheduled the job of pulling the seven mile pipeline into place in the middle of May.

The Ocean outfall for effluent discharge is a 12-ft diameter, 5-mile long pipeline of reinforced concrete. The inshore portion of the effluent outfall will be buried beneath the ocean floor in a trench excavated for that purpose. However, the remainder of the pipe will be laid on the ocean floor, and will have no protection except rock tremied around it up to the spring line. The main pipe of 12-ft diameter



HEAVY SOLID LINE REPRESENTS PRESENT SEWER PIPE. SLASHED LINES SHOW PROPOSED PIPELINES.

will terminate five miles from shore, but from that point there will be two, 4000-ft legs which comprise the diffuser sections. Holes varying from 6¾ to 8⅛ in. diameter will be spaced along the spring line of the diffuser sections. Bids for the effluent discharge pipeline were scheduled to be received in May.

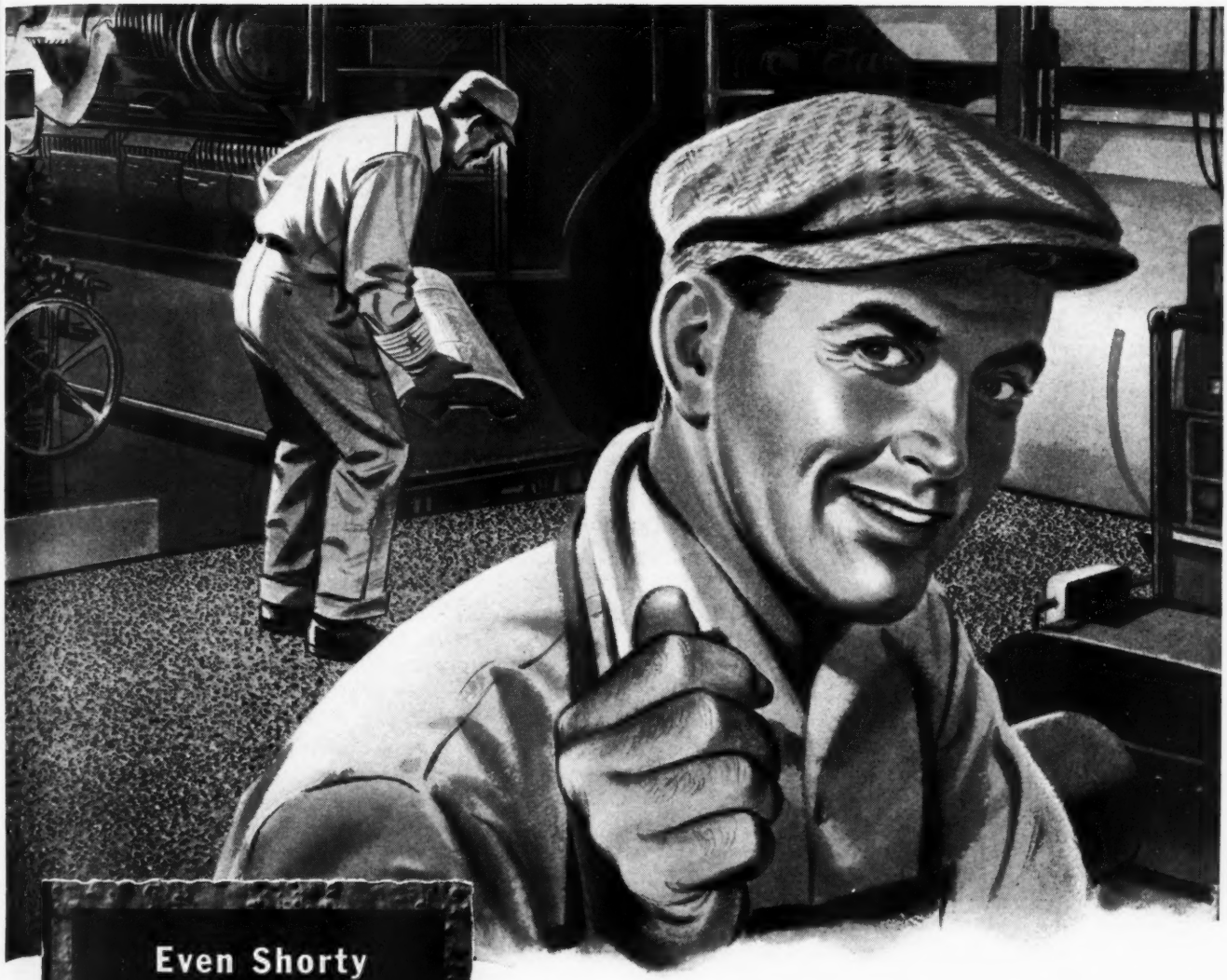
Seattle Consulting Firm Designs $40 Million Dry Dock

Carey and Kramer, Seattle, Wash., is designing jointly with Moran, Proctor, Mueser and Rutledge, New York, N.Y., a graving drydock for the Bremerton Naval Station, which is said to be the largest in the world. Carey and Kramer also designed a sewerage system for the Bremerton Navy Yard which included some nine automatic sewage pump stations and two miles of cast iron sewer lines at a cost of $700,000.

The engineering firm also is designing for the City of Seattle, jointly with City Engineer R. W. Morse and staff, the proposed new earth fill dam and concrete spillway on the Tolt River for an additional water supply source for the city. The approximate cost of the dam is estimated at $7 million. Other work for the City of Seattle and the Lake City Sewer District includes a sewage treatment plant and 1½ miles of pressure lines on the shore of Lake Washington to cost $1.45 million.

Sewerage systems and treatment facilities are being designed for the following cities in Washington: Redmond, $350,000; Houghton, $300,000; Monroe, $175,000; Raymond, $325,000; and Snohomish, $475,000. Water and sewerage systems have been designed for Overlake Park, Inc., a commercial district between Bellevue and Redmond, $450,000; and for the Mercer Island Water and Sewers districts, $1.92 million. Engineering service is being provided for the rehabilitation of the Shelton, Wash., sewerage system, to cost $90,000.

A proposed new hydroelectric project on Blue Lake at Sitka, Alaska, has been designed by the Seattle engineering firm. The cost of the project will



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"Even Shorty doesn't slip" sums up the ALGRIP safety story. ALGRIP's exceptional non-slip properties result from a patented process in which a grinding-wheel type abrasive is rolled—*not coated*—to a controlled depth as an *integral* part of tough steel plate. Usage merely exposes more abrasive.

Make a test installation in your worst slipping area. Use ALGRIP as an overlay or as independent flooring—it fabricates easily and requires no maintenance. Try it—and watch your ALGRIP installation pay for itself as accident and insurance rates go down.

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be approximately $4 million. Another important assignment for this firm was the site engineering work on 12 aircraft hangars or shelters for the U.S. Army and U.S. Air Force.

Prestressed Concrete Institute Plans

Four standard cross sections for prestressed concrete beams to be used in highway bridges for spans of 30 to 100 feet have been developed by a joint AASHO-PCI committee.

G. S. Paxton, chairman of the American Association of State Highway Officials Bridge Committee, appointed a subcommittee composed of W. E. Dean, Tallahassee, Fla.; C. A. Marmelstein, Georgia; and Randle B. Alexander, Texas. To work with this subcommittee, the Prestressed Concrete Institute appointed Ben C. Gerwick, Jr., president of Ben C. Gerwick, Inc., San Francisco; Charles C. Zollman, Consulting Engineer, Springfield, Pa.; and George W. Ford, R. H. Wright & Son, Inc., Fort Lauderdale.

A print of the sections has been mailed to PCI members. For information on availability of the plans, write the PCI Publication Office, 3132 N.E. 9th St., Fort Lauderdale, Fla.

The PCI World Conference on Prestressed Concrete, opening July 29 and running to August 2, in San Francisco, Calif., will include many sessions of particular interest to consulting engineers.

July 30: Prestressed Concrete Bridges
Prestressed Buildings
July 31: Field trips
Aug. 1: Design and Construction in Various Countries.
Prestressed Pavements, Wharves, Piles, and Poles.
Aug. 2: Research on Prestressed Concrete.

Registration blanks are available from the Department of Conferences & Special Activities, University Extension, University of Calif., Berkeley 4.

Kentucky Turnpike Promotion Urged by Bond Holders

The Kentucky State Highway Department has been charged with supressing an engineering report by the New York firm of Cloverdale & Colpitts recommending a more comprehensive sign and advertising program for the Kentucky Turnpike. In making the statement, T. Henry Boyd, vice president of Blyth & Co., New York investment banking firm, acted as spokesman for holders of toll highway bonds at a meeting held to discuss the turnpike's $300,000 operating budget for the next fiscal year.

He warned that Governor Chandler and the highway department may have trouble selling the state's contemplated $100 million general-obligation bond issue unless they change their attitude toward the turnpike. The state's failure to advertise the turnpike adequately, or to post sufficient signs informing motorists where the road leads and how to get on it, were called inefficient administration.

Boyd contended that the state owes it to its motorist-taxpayers to make the turnpike self-supporting, instead of allowing it to continue to be a costly burden on the state road fund. Present official attitudes toward the turnpike were charged with being partially responsible for the fact that the road is earning only about 83 percent of the money necessary to pay interest on the outstanding bonds.

The $100 million general-obligation highway bond issue to which Boyd referred was authorized by Kentucky voters last year. As soon as a final court ruling on its validity has been handed down, the bonds will be offered for sale to provide money for matching available federal aid funds for expansion of the state's free highway system.

Iowa Association Holds First Annual Meeting

The Iowa Association of Consulting Engineers held its first Annual Meeting in May at the Fort Des Moines Hotel, Des Moines.

President for the 1957-58 year is Sherman Smith, of Burlington; vice president is E. F. Beheiss, Des Moines; secretary, Robert Rosine, Belmond; and

treasurer, Frank Paly, Des Moines. Directors elected for one-year terms are: Ralph Wallace, Mason City; M. L. Patzig, Des Moines; and Robert Brice, Waterloo. Directors for two-year terms are: Paul Walters, Des Moines; Eugene Davis, Des Moines; and Neil Carpenter, Ames.

L. K. Crawford, secretary of the Consulting Engineers Council and president of the Illinois Association of Consulting Engineers, was the luncheon speaker. At the evening session Hunter Hughes, editor of CONSULTING ENGINEER, spoke. Also present as guests were Edward Wolff, of Chicago, president of CEC, and Charles Pate, of Tulsa, 1st vice president.

Tilt-Up Slabs Cut Costs

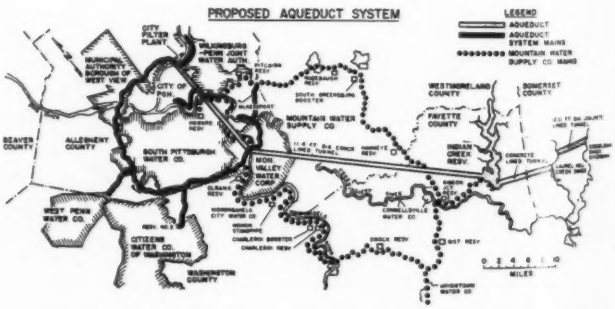
Falk and Booth, San Francisco, Calif., supplied structural engineering and architectural service for the construction of the recently completed Fullerton, Calif., plant of Growers Container Co., Salinas, Calif. This is the third corrugated paper box plant for which they have been responsible for engineering and architectural service, the other plants of similar construction being located at Jacksonville, Fla., and Salinas, Calif.

The Fullerton plant contains 150,000 sq ft of floor space. It cost $1,130,000 exclusive of the equipment, which runs about $1,300,000. Walls are of tilt-up concrete slab construction. The concrete floors are poured first, and after curing serve as the casting floor in the production of the reinforced concrete wall slab panels. There are 76 tilt-up panels, each weighing approximately 18 tons. Each panel slab is 6-in. thick and 19-ft wide and 25-ft high. A 3500-lb concrete is used. About three weeks were required to form and pour slabs on the floor, but they were erected in 13 working hours. Each wall panel has projecting reinforcing steel tied into the reinforced concrete columns, which are poured after panels have been erected by a crane. Walls are later finished with a concrete masonry paint. Roof trusses, with a span of 100 ft, have an 8- x 8-in. laminated wood bottom chord and a top chord of solid timber, 8 x 12-in. An interesting feature of the Fullerton plant are the frosted, heat-absorbent glass sun screen panels on the western exposure. Each panel is 5-ft 6-in. high and 20-ft long, with steel supports cantilevered from the walls. The panels are placed so that a man standing at the window would see the bottom of the sun screen panel at eye level, allowing maximum light to penetrate without any sun glare. Dan Vandament supplied the mechanical engineering, and Darmsted the electrical engineering.

Underground Aqueduct and Reservoir Proposed for Western Pennsylvania

A $250 million plan to bring mountain spring water to four Western Pennsylvania counties has been proposed by the American Water Works Co. Plans call for construction of a 134-billion gallon reservoir in the mountains southeast of Pittsburgh and a gravity-flow underground aqueduct to carry the water across four counties.

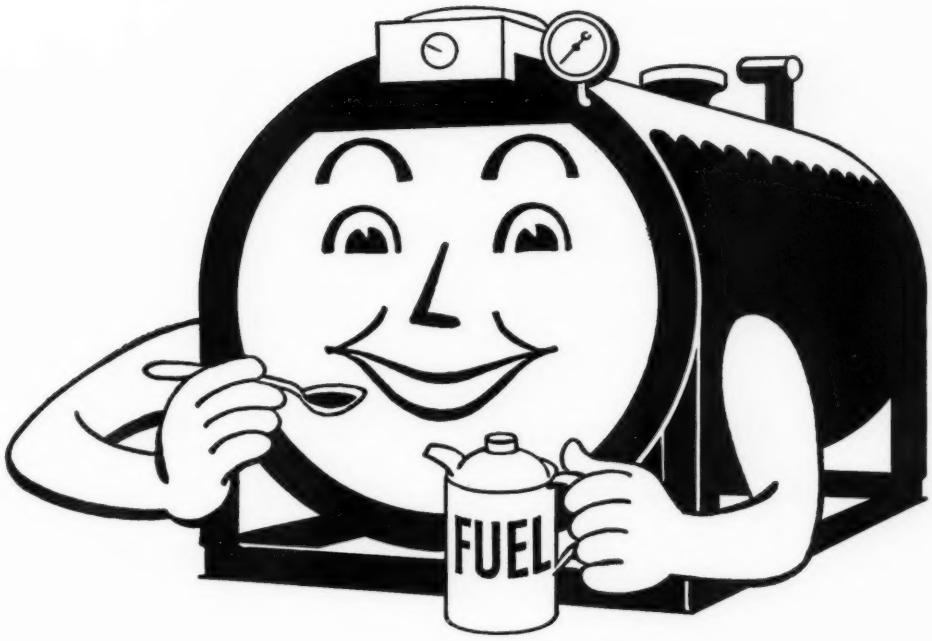
A dam and a series of valleys would form the reservoir on Indian Creek, in Fayette and Westmoreland Counties, which would be fed by the Indian and



PROPOSED SYSTEM WOULD FURNISH MOUNTAIN WATER TO WESTERN PENNSYLVANIA COMMUNITIES.

Laurel Hill Creeks, with future additional supply of water available by diversion of the Casselman River.

A concrete-lined, underground aqueduct 11.4 feet in diameter and approximately 42-miles long would be constructed at an average depth of 800 feet below surface to transport the water. The aqueduct from the reservoir to Laurel Creek would be another 7.3-



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Every Continental Automatic Boiler is on a strict reducing diet. That's because it's specifically designed to consume less fuel . . . to give you more steam at lower cost.

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Every Continental Automatic Boiler – in sizes from 20 to 500 hp – has a guaranteed efficiency of more than 80%. As an engineered product, all its parts function smoothly together . . . give quiet, low-cost operation . . . vibration-free performance. For more details, send for Bulletin BE-3.

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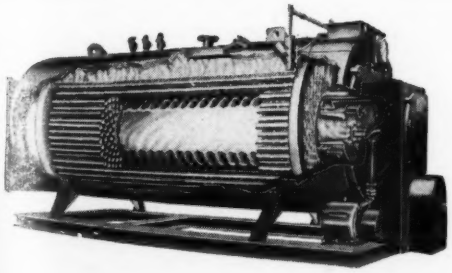


(Left) Series F Continental Automatic Boiler, with modulating control. Other models from 20 to 500 hp, with on-off or modulating controls, burn oil and/or gas. For steam heating or process work at pressures from 15 to 250 pounds, or for hot water heating at low or high temperatures.

A HALF CENTURY OF BOILER MANUFACTURING EXPERIENCE

miles long and the aqueduct to the Casselman River another four miles. The aqueduct would have a daily capacity of 650-million gallons.

The reservoir would have a water level of 1450 feet elevation above sea level for the 134-billion gallon capacity and a 1460 feet elevation for a 151-billion gallon capacity, if needed.

These four countries presently draw water from the Monongahela, Allegheny, and Youghiogheny.

Registration Board Reminds Land Surveyors of Limits of Practice

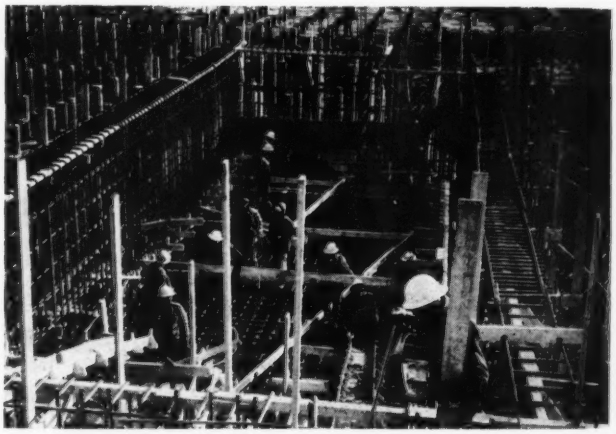
The State of Virginia Registration Board has ruled that the designing of road and street gradients or grades and storm water drainage systems constitutes the practice of highway engineering, a branch of civil engineering, and so may not be practiced by land surveyors. It had been brought to the attention of the Board that certified land surveyors were submitting such plans to local building inspectors.

The Board has advised each registered land surveyor in Virginia to confine his practices to the limitation set forth in the law, which reads, " 'Land surveying' refers only to surveys for the re-establishment of land boundaries and the subdivision of land and such topographic work as may be incident thereto, the making of plats and maps and the preparing of descriptions of land so surveyed or investigated."

Progress Report on Memphis Power Station

The Thomas H. Allen Station, designed for the Light, Gas, and Water Division of the City of Memphis by Burns and Roe, Inc., New York, will have a name-plate rating of 750,000 kw, with a gross capability of 826,500 kw.

Over two million pounds of reinforcing steel bars have been placed, including those in the turbine mat,



REINFORCING STEEL USED FOR CONDENSATE PIT IS MOSTLY NO. 10 BARS SPACED ON 10-IN. CENTERS FOR MAXIMUM IN STRENGTH AND RIGIDITY.

the floor, and the walls of the condensate pit, and some 8823 cu yds of concrete have been poured.

Foundation of the plant is supported by 6300 piles, driven to depths up to 60 feet.

ASCE to Work on Pipeline Crossing Specifications

The recently established Pipeline Division of the American Society of Civil Engineers has set up a 25-man committee to develop a standard set of specifications for pipeline crossings under railroads and highways. Citing the need for such a standard, Chairman J. E. Thompson, of the Natural Gas Pipeline Company of America, pointed out that the many different and varied specifications now in use have made it increasingly difficult for pipeline companies to obtain the proper materials and design for each individual condition, since materials often must be ordered two years in advance of construction, and many times before crossing permit data is available.

When the specification standards have been approved by the Pipeline Division members, they will be submitted to the American Standards Association for approval. ▲▲

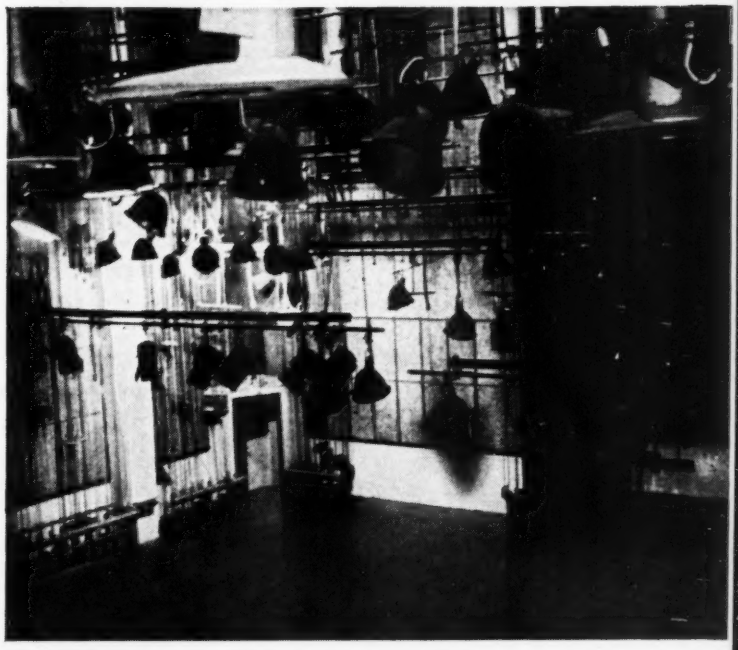
How ANEMOSTAT
Air Diffusers help make movies

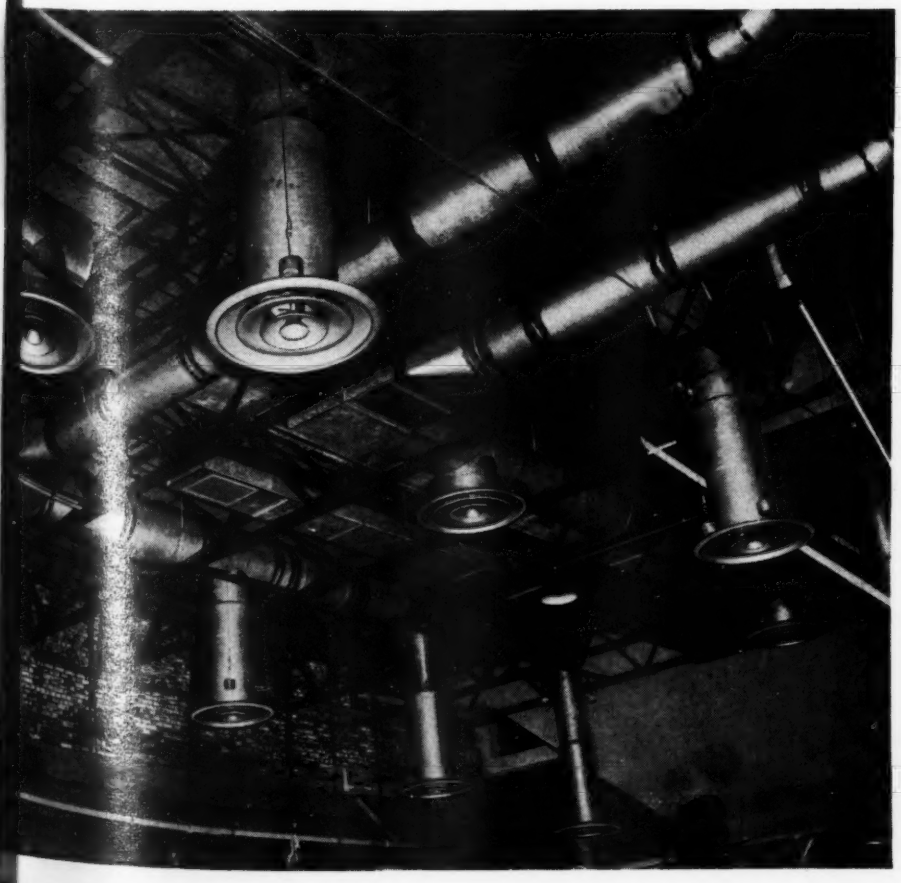
A carefully designed air conditioning system enables Production Center, Inc. to make movies at top speed during the hot summer months. In fact, production has been increased by three to four times, according to Center estimates.

Anemostat Air Diffusers help do this vital job. They draftlessly diffuse 20,000 cubic feet of cooled air per minute pushed by giant fans through the soundproofed ducts. The two main studios have 32 vertical ducts, ranging in diameter from 18 to 24 inches; of these, 24 are telescopic and can be raised or lowered to suit requirements. The conditioned air, efficiently distributed by Anemostat Air Diffusers, offsets the heat from the tremendous wattage of the lights needed for film-making.

Movie-viewing, as well as movie-making, is aided by Anemostat Air Diffusers. They are installed in hundreds of theatres throughout the country. Anemostat Air Diffusers also provide *true* draftless comfort and uniform air distribution in schools, hospitals, banks and practically all types of commercial and industrial buildings.

One of three *completely air conditioned* sound stages at Production Center, Inc. in New York City.





Note the Anemostat Air Diffusers installed on the telescopic ducts.

Joseph B. Klein, Architect
Robert Glenn, Inc., General Contractor
Wolff & Munier, Inc.,
Mechanical Contractors

For complete data, write for your copy of the new Anemostat Selection Manual No. 60 to Anemostat Corporation of America, 10 E. 39th Street, New York 16, N. Y.

Men in Engineering

M. E. Fiore, Associate in the firm of Parsons, Brinckerhoff, Hall & Macdonald, N.Y.C., has been appointed to membership on the Joint Committee on Composite Construction of the American Concrete Institute and the American Society of Civil Engineers. He is also PBH & M representative in the Prestressed Concrete Institute. Another Associate in the firm, H. Alden Foster, has been made a Life Member of ASCE.

At Ebasco, Charles Weisman, structural engineer, has joined the architecture-structural engineering division of the Design and Construction Dep't. In the D & C electrical design division new engineers are: Julius M. Masheroni, senior designer, and Alexander Pruglo, designer. Paul C. Kenson, Jr. and Henry C. H. Mohn have joined the mechanical design division as senior designers.

In the structural design division of D & C are Reuben Boblow, Matthew E. Lambert, and Friedo H. Wiegmann as designers. Reuben S. Goodell joins the Space Planning Dep't. as a consultant; Clarence R. O'Neal, as staff analyst; and Roger L. Randall, as analyst.

The partnership of Dwyer, Sanders & Kite has changed its name to Dwyer & Kite, Consulting Engineers. Members of the partnership are T. Paul Dwyer and Bill M. Kite.

The Endowment Fund of the Engineering Foundation has been increased by 100 shares of General Motors stock, a gift of Professor Orlan W. Boston, of Ann Arbor, Mich. Professor Boston, a Fellow of the American Society of Mechanical Engineers, directed that the stock be invested by United Engineering Trustees, Inc., and income from it is to be "used for the furtherance of research in science and engineering."

Allen P. Richmond, Jr., assistant to the secretary of the American Society of Civil Engineers, has retired from the organization's headquarters staff in New York, on which he served for a period of 27 years.

William S. Hurley, Jr., consulting engineer, has moved his office to 2536 Euclid Ave., Cleveland.

R. N. Bergendoff, of Howard, Needles, Tammen & Bergendoff, and General L. J. Sverdrup, president of Sverdrup & Parcel, Inc., have been elected trustees of the Midwest Research Institute, of Kansas City, Mo.

The American Institute of Electrical Engineers has elected Walter J. Barrett as president for the 1957-58 year. He is a Fellow of AIEE and is with New Jersey Bell Telephone Co., Newark, N. J. L. F. Hickernell, Anaconda Wire & Cable, is the new treasurer. Vice presidents are Benjamin R. Teare, Jr., Carnegie Institute of Technology; Herbert W. Oetinger, Duke Power Co.; Albert G. Johnson, Omaha Public Power District; Orien A. Gustafson, Pacific North-

west District, General Electric Co.; and Gordon F. Tracy, University of Toronto.

L. C. Bishop, state engineer and ex officio secretary of the Wyoming Board of Engineering Examiners, has retired from office. Dr. Bishop is one of the sixteen registrants who still carries a Certificate of Registration issued in 1907 by the Board of Examining Engineers after he passed the first examinations ever given to licensed engineers and land surveyors. He will maintain a limited consulting practice in irrigation engineering from his home in Cheyenne, Wyo.

All members of last year's board of directors of Gibbs & Hall, Inc. have been re-elected to serve another year. They are Edward H. Anson, Edward L. Champion, Barclay G. Johnson, Ernest C. Johnson, Boris Lochak, John B. Saxe, David B. Sloan, Harold C. Strait, John B. Westbye, and H. Everett Woodruff. The board also re-elected the same officers: David B. Sloan as president; Edward H. Anson as senior vice president; John B. Saxe as vice president and chief engineer; Barclay G. Johnson as secretary; and Norman D. Campbell, treasurer.

Foster D. Snell, Inc., consulting chemical engineers, New York City, have appointed Richard S. Ringheim as director of marketing and economic research.

Clarence A. Graether, who joined the architectural-engineering firm of Smith, Hinchman and Grylls Associates, Inc. 53 years ago, retired June 1. A consultant in general building construction, he has served longer than any other staff member. President Wallace S. MacKenzie is next in length of service, with 41 years.

At the annual meeting of the American Institute of Electrical Engineers, Dr. Harold H. Beverage received the 1956 Lamme Gold Medal in recognition of his pioneering and outstanding achievements in the conception and application of principles basic to progress in national and worldwide radio communications. Dr. Beverage is vice president, research and development, RCA Communications, Inc., and director of the Radio Research Laboratory, of RCA Laboratories.

The Illinois Chapter of the American Society of Heating and Air Conditioning Engineers has elected Harvey E. Anderson as president, Herbert Kreisman as vice president, John C. Scott as secretary, and E. P. Heckel, Jr. as treasurer.

Harold Becher, consulting engineer, New York City, and a member of the Association of Consulting Chemists and Chemical Engineers, has been elected president of Kings County Chapter of the New York State Society of Professional Engineers.

The firm of Pfeiffer and Schwegmann has been dissolved with the retirement of David C. Pfeiffer. Pfeiffer moved to Southern Methodist University, Dallas, Texas, as Director of Physical Plant. The

Baker Hosts School Visitors

Robert L. John, exec. vp, Michael Baker, Jr., Inc., Rochester, Pa., shows drawing to some of the 83 Penn State Univ. students and faculty who visited Baker's offices. Grouped around Mr. John (wearing glasses) are, l. to r.; Robert Price, student; Harmer Weeden, assoc. prof; and Thomas J. Powers, student.

new firm, of Winston and Schwegmann, will be located at 3132 Dyer St., Dallas. Paul R. Winston, mechanical engineer, and J. F. Schwegmann, electrical engineer, are principals of the new firm.

Kelley & Gruzen have announced appointment of Dr. Sanford Bates, penologist and authority on planning and administration of social service institutions and hospitals, as technical consultant. He will serve as an adviser in the planning and design of penal, welfare, and hospital buildings.

SCHWERIN HARPER

At the Cleveland, Ohio, firm of Fischer & Associates, Inc., William H. Harper and Charles H. Schwerin have been elected to the board of directors. Harper also becomes secretary of the corporation.

A second national award for design of the Medical Towers Building, Houston, Texas, has been presented by the honor awards committee of the American Institute of Architects to Golemon & Rolfe, Architects, Walter P. Moore and K. E. Zimmerman, structural engineers, and Bernard Johnson, of Bernard Johnson & Associates, mechanical and electrical engineers.

R. C. Anderson has opened an office as a consulting metallurgist at 7738 Park Place Blvd., Houston.

Four pioneers in the respective fields of electric furnaces, refractories, gas burners, and protective atmospheres, have received the Trinks Industrial Heating Award. The four are: Samuel Arnold, 3rd, consulting engineer, Pittsburgh; H. M. Christman, Massillon Refractories Co.; W. Barton Eddison, consulting engineer, Ardsley-on-Hudson, N. Y.; Allen G. Hotchkiss, General Electric Co.

Joseph Kiell has moved his office to new quarters at 10 East 40th St., New York City.

The firm of H. A. Stepleton & Company, located in the Colton Building, Toledo, Ohio, has changed its name to H. A. Stepleton & Associates, Consulting Engineers. New address is 4528 Monroe St., Toledo, Ohio.

Ebasco Services Inc. have opened an office in San Francisco with Harvey K. Breckenridge as manager. Breckenridge joined Ebasco in 1954 and since that time has been general manager of the Greek Electrification Program, which Ebasco has been handling for that country, with offices in Athens, Greece.

Dr. B. D. Thomas, director of the Battelle Memorial Institute, has been awarded an honorary degree of Doctor of Engineering by Michigan College of Mining and Technology.

E. G. Robbins and Frank L. Whitney have been elected to the board of directors of Walter Kidde Constructions, Inc. Robbins is vice president in charge of construction and Whitney is vice president in charge of engineering.

WHITNEY WAGNER

A. V. Smith Engineering Co., Narberth, Pa., announces election of John Wagner, Jr., as vice president. He will direct field corrosion studies and research work.

Reginald F. Taylor, Consulting Engineer, and H. E. Bovay, Jr., Consulting Engineers, Houston, Texas, have joined forces. Taylor will serve as engineering consultant in the Bovay organization and his staff will become a part of the Bovay staff. ▲▲

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DAY-BRITE LIGHTING MAKES THE BIG DIFFERENCE HERE

There's no compromise here

In the laboratory, under a microscope, life itself may hang in the balance. Vital work done here demands the best in lighting—Day-Brite lighting that provides better over-all illumination, without tricky shadows or glare.

Don't take our word for it. Compare fixtures. We'll stake our reputation on what you find. For we *know* you'll find that Day-Brite does offer better lighting . . . is built to last years longer . . . does offer cost-cutting maintenance in an attractive fixture design.

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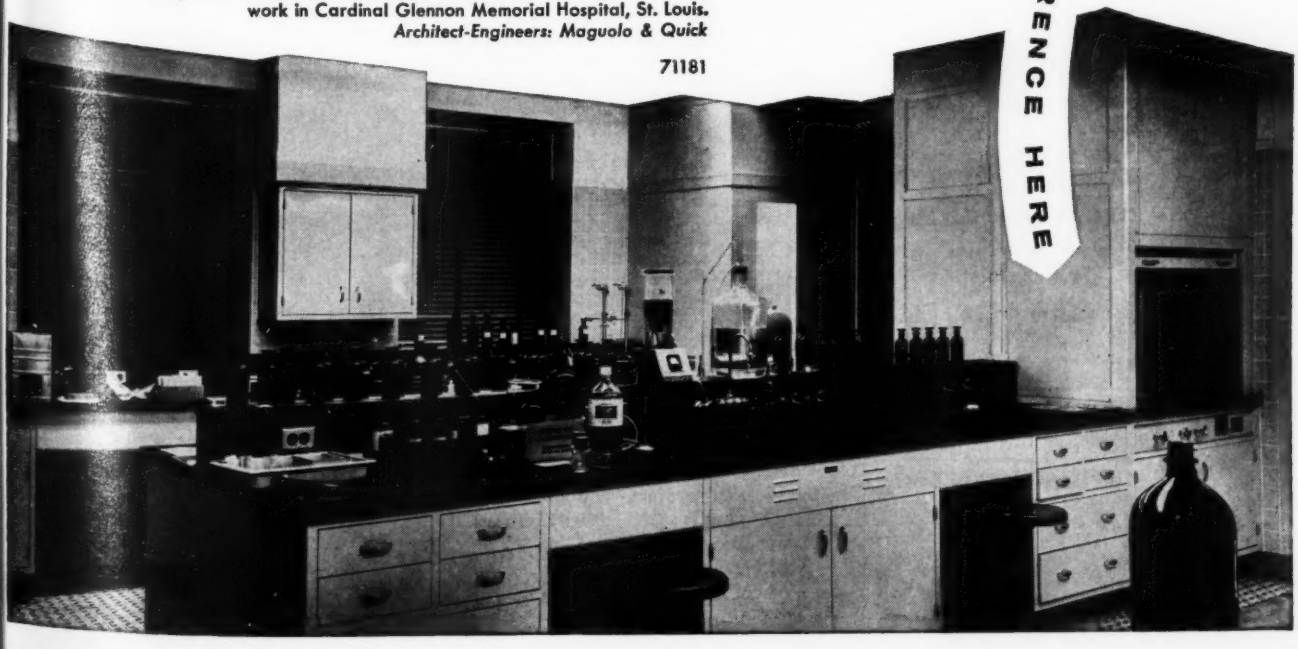

New Projects Reported

By Consulting Engineers —

ALABAMA

Ammons, McClure & Caldwell, Atlanta, Ga.
Val Monte Shores, Inc., Guntersville, Ala. (mech.) Client, Architect, Albert C. James.

Ammann & Whitney, New York, N.Y. Reinforced concrete field house, University of Alabama, 260 x 340 ft barrel arch type. (struc., mech., elec.) $2,000,000. Client, University of Alabama.

ARKANSAS

John T. Pullen, Consulting Engineer, Memphis, Tenn.
Field house and gymnasium, Blytheville, Ark. $260,000. Client, U.S. Branson, Arch., Blytheville.

First Methodist Church, Blytheville, Ark. $350,000. Client, U.S. Branson, Arch., Blytheville.

Harold L. Smith & Assoc., Stuttgart. Sewage treatment facilities and collection system. (civil) $410,000. Client, City of West Helena, Ark.

Water distribution system. (civil) $100,000. Client, City of Lake Village.

Sewage treatment facilities and collection system. (civil) $250,000. Client, City of Lake Village, Ark.

Water and sewerage improvements. (civil) $145,000. Client, City of Parkin.

Water improvements and treatment plant. (civil) $125,000. Client, City of Ola, Ark.

New water and sewerage systems. (civil) $175,000. Client, City of Weiner.

CALIFORNIA

Neptune & Thomas, Architects & Engineers, Pasadena, Calif.
Westminster high school. Complete new reinforced concrete school for 500 students. $2,500,000. Client, Huntington Beach School District, Calif.

Adams, Morgan, Latham, Kripp & Wright, Long Beach, Calif.
Storm drain project #129, North Long Beach Pump District. (civil) $1,600,000. Client, City of Long Beach.

Storm drain project #130, Pump District #7. (civil) $2,160,000. Client, City of Long Beach.

El Dorado Park nursery. (arch., civil, struc., mech., elec.) $300,000. Client, City of Long Beach.

Crown Bowling Alley. (arch., struc., mech., elec.) $200,000. Client, Crown Bowling, Inc.

Office building for attorneys. (arch., struc., mech., elec.) $80,000. Client, John E. McCall.

John D. Swearingen, Mill Valley, Calif. Redesign 50-ton flotation mill, reopen underground workings, and diamond drilling, Palisade silver mine, Napa County, Calif. $40,000 (mill), $50,000 (mine rehabilitation) Client, Intermountain Exploration and Development Co., Modesto, Calif.

M. K. Goldsmith, Los Angeles, Calif. Botany building, U.C.L.A. (struc.) $750,000. Client, Paul R. Williams, Arch.

Linde office building, Beverly Hills. (struc.) $500,000. Client, Paul R. Williams, Arch.

Statler Hotel addition, Los Angeles. (struc.) $500,000. Client, Nickman & Chow, Arch.

R. E. Layton & Assoc., San Leandro. Provide engineering for major manufacturing building renovation and machinery setting for new equipment, including structural and mechanical renovations. (civil, struc., mech.) $75,000. Client, California Pottery Co., Niles.

Two-story structural addition to drafting room and manufacturing. (struc.) $60,000. Client, Friden Calculating Machine Co., Inc., San Leandro, Calif.

Site studies for grading, paving, drainage, and site development for elementary school. (civil) $50,000. Client, San Leandro Unified School District, San Leandro, Calif.

Merrill B. Wittman, El Cajos, Calif. Sanitary sewers. (civil) $810,000. Client, City of El Cajos.

Study of master drainage system. (civil) $1,500,000. Client, El Cajos.

Street improvements. (civil) $40,000. Client, City of El Cajos.

Douglas Street improvements. (civil) $145,000. Client, City of El Cajos.

Oro Street improvements. (civil) $30,000. Client, City of El Cajos.

Study of all streets and recommendations. (civil) Client, Imperial Beach.

Subdivision for Grable. (civil) $180,000. Client, Grable County.

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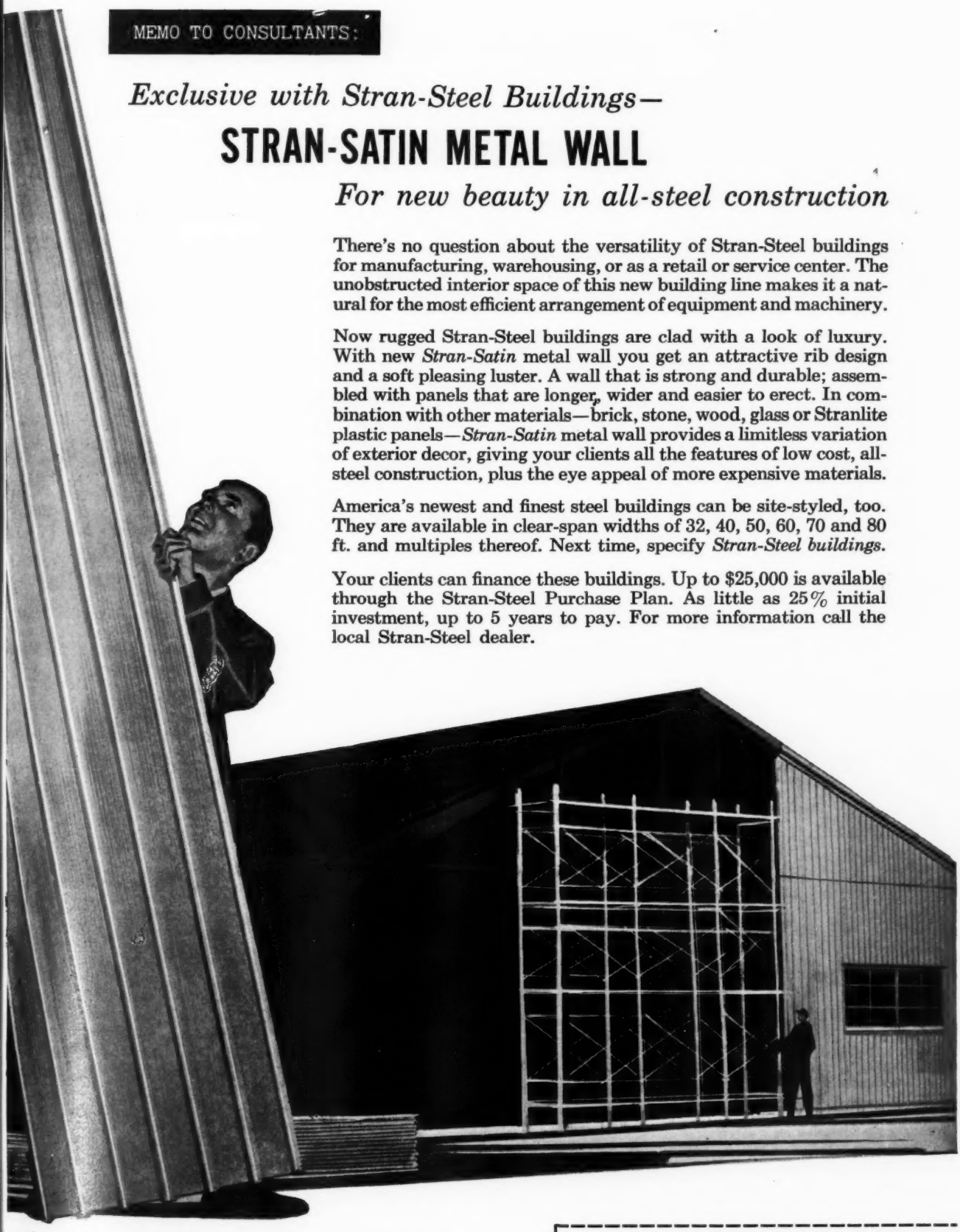

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Leonard D'Ooge, Sacramento, Calif.
Wonderfood Market and shopping center, Sacramento, Calif., 20,000 sq ft. (mech.) $98,000. Client, Big Six Co.

Foothill Center suburban shopping center, 16,000 sq ft market, 24,000 sq ft shops and stores. (civil, struc., mech., elec.) $600,000. Client, Market Dev. Co.

William H. Kirkgaard, Glendale, Calif.
Apartment houses and garage. (struc.) $84,000. Client, Crestlane Building & Investment Co.

Add mezzanine to warehouse. (civil, struc.) $11,000. Client, W. Edwards.

COLORADO

Ken R. White, Denver, Colo.
Preliminary studies for extension of east-west runway and new north-south runway, Stapleton Field, Denver, Colo. (civil) Client, City and County of Denver.

CONNECTICUT

Henri B. van Zelm and Assoc., West Hartford, Conn.
Connecticut Medical Service, Inc. office building, New Haven, Conn. (mech., elec.) $1,500,000. Client, Office of Douglas Orr.

Office building, Remington Arms, Inc., Bridgeport, Conn. (mech., elec.) $1,000,000. Client, Office of Douglas Orr.

Henry A. Wolcott Elementary School, West Hartford, Conn. (mech., elec.) $750,000. Client, Willard Wilkins.

Orville Platt High School, Meriden, Conn. (mech., elec.) $2,288,512. Client, Willard Wilkins.

Maloney High School, Meriden, Conn. (mech., elec.) $2,200,000. Client, Willard Wilkins.

Printing plant, Connecticut Printers, Inc., Bloomfield, Conn. (mech., elec.) $400,000. Client, Buck and Buck.

Gymnasium, Loomis Institute, Windsor, Conn. (mech., elec.) $500,000. Client, Jeter and Cook.

Gaud-Reau Assoc., Westport, Conn.
Material Handling Handbook. Functional presentation of solutions developed by industry at large in mechanization of material handling problems in plants, warehouses, and terminals. (mech.) $70,000. Client, McGraw-Hill Book Co.

DISTRICT OF COLUMBIA

Herbert Manuccia, P.E. and Assoc., Washington, D.C.
Library of Congress, Washington, D.C., exterior subterranean vaults. (struc.) $150,000. Client, **Guy Panero Engineers.**

Edward T. Johnson & Assoc., Wash., D.C.
Prepare industrial maintenance manuals, U.S. Marine Corps. $276,098.40. Client, U.S. Marine Corps.

Prepare asphalt and concrete operational manuals, U.S. Army (ERDL). $4641.35. Client, U.S. Army Corps of Engineers.

FLORIDA

Frederick L. Bell & Assoc., Inc., Tallahassee, Fla.
Comprehensive parking study downtown St. Petersburg, Fla., and county-wide traffic survey, Pinellas County, Fla. (civil) $100,000. Client, Florida State Road Department.

Col. A. B. Jones, U.S.A. (Ret.), Miami Beach, Fla.
Marshalling witnesses, assembling data, and preparing exhibits for Hillsboro Inlet Committee to be presented at public hearing by U.S. District Engineer on proposed improvement of navigation in Hillsboro Inlet, Fla., by Federal Government. (civil).

J. E. Curley & Assoc., Miami, Fla.
McArthur High School, Broward County, Fla. 1700-pupil high school, water treatment plant, central hot water heating, 277/480-v electrical system, 10 classroom wings. (mech., elec.) $1,200,000. Client, Start & Moeller, Arch.

DeLeuw, Cather & Brill, New York, N.Y.
North-South Expressway, Miami, Fla. Surveys, contract plans, and estimates for 2 miles of limited access highway in Miami, including 5 grade separations, high level crossing of Miami River and interchange. (civil, struc., elec.) $20,000,000. Client, Florida State Road Dept.

Alexis B. Knonoff Consulting Engineers, Miami, Fla.
300-ton incinerator, Coconut Grove Section, Miami, Fla. (civil, struc., mech., elec.) $900,000. Client, City of Miami.

Sewage collection system and treatment plant, Dade County Home and Hospital, Dade County, Fla. (civil, struc., mech., elec.) $150,000. Client, County.

Sewer and water systems, Mashta Island, Dade County, Fla. (civil, struc., mech., elec.) $125,000. Client, Mashta Land Corp.

Jacob Feld, New York, N.Y.
Hotel Carrilon, Miami Beach, Fla. $10,000,000. Client, Carol Management Corp. and Carol Florida Corp., owners.

Jack E. Mitchell & Assoc., Coral Gables.
North Miami Beach Junior High School. (mech., elec.) $900,000. Client, Steward-Skinner Assoc.

Officer nurses' quarters, Homestead Air Force Base, Homestead, Fla. (mech., elec.) $150,000. Client, Steward-Skinner.

Addition to 20th Street airport terminal, Miami, Fla. (mech., elec.) $1,250,000. Client, Steward-Skinner Assoc.

Delta Air Lines maintenance and overhaul facilities, Miami International Airport. (mech., elec.) $500,000. Client, Steward-Skinner Assoc.

Food Fair Supermarket, Orlando, Fla. (mech., elec.) $300,000. Client, **L. I. Taylor, Structural Engineer.**

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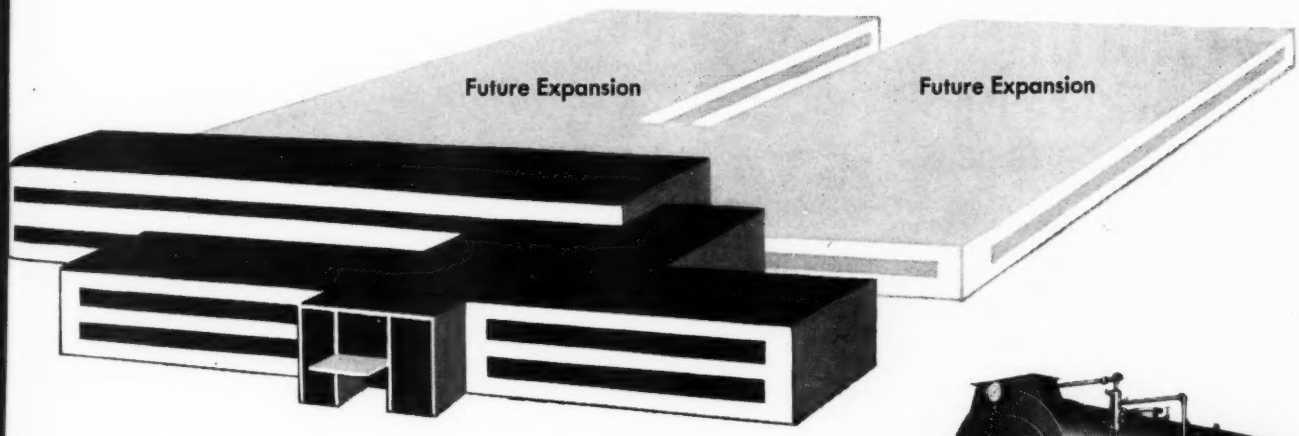

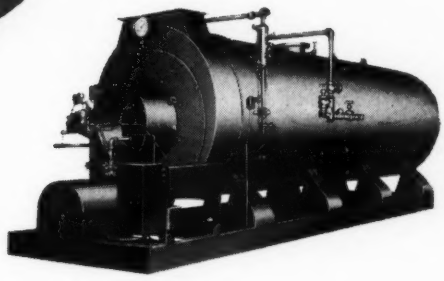

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Please send me your booklet *Cyclotherm Cyclonic Combustion*, also rotogravure copy of *Cyclotherm Sales Steam* with illustrations and descriptions of Cyclotherm installations.

University of Miami, Medical School research laboratory bldg. (mech., struc.) $2,250,000. Client, Steward-Skinner.

GEORGIA

J. C. Harrison, Spartanburg, S.C.
170-unit apartment building, Atlanta. (mech.) $2,275,000.

Ammons, McClure & Caldwell, Atlanta.
Paulding County Hospital, Dallas, Ga. (mech.) $250,000. Client, Arch., Wilfred J. Gregson.

Wayne County Memorial Hospital, Jesup, Ga. (mech.) $1,000,000. Client, Arch., Wilfred J. Gregson.

Briarcliff Elementary School, DeKalb County, Ga. (mech.) $370,000. Client, Arch., Wilfred J. Gregson.

Vinson & Co., Inc., Atlanta, Ga.
Bibb County, Ga., water system. (civil) $4,500,000. Client, County Council.

Jackson County, Ga., water system. (civil) $2,500,000. Client, County Coun.

Haharia, Ga., sewer system. (civil) $400,000. Client, Mayor and Council.

Kingsland, Ga., sewer system. (civil) $350,000. Client, Mayor and Council.

IDAHO

Stevens & Thompson, Portland, Ore.
Sewers and sewage treatment. (civil) $835,000. Client, Lewiston, Idaho.

Outfall sewer and improvements. (civil) $300,000. Client, Moscow, Idaho.

ILLINOIS

Hazelet & Erdal, Louisville, Ky.
Calumet Skyway. $8,000,000. Client, City of Chicago, Ill.

Illinois toll road, 1 mile. $6,000,000. Client, Ill. Dept. of Hwys.

Russell & Axon, St. Louis, Mo.
Sewer trunk lines, pumping station, extensions. $100,000. Client, City of Columbia, Ill.

Waterworks. (civil, struc., mech., elec.) $135,000. Client, Westmont, Ill.

Railroad bridge. (civil, struc.) $75,000. Client, Northbrook, Ill.

Pavement projects. $200,000. Client, Northbrook, Ill.

Storm sewer. $150,000. Client, Northbrook, Ill.

Roscoe Street sewer. (civil) $1,300,000. Client, City of Chicago.

Armitage Ave. underpass, Northwest Superhighway. (civil, struc.) $1,250,000. Client, City of Chicago.

North Ave. underpass, Northwest Superhighway. (civil, struc.) $1,250,000. Client, City of Chicago.

INDIANA

Hannan, Meek and Cordill, Indianapolis, Ind.
Install elevator in present court house building. Client, Board of County Commissioners, Grant County, Marion, Ind.

Robert E. Taylor Engineering, Fort Wayne, Ind.
Initial section 100 x 200 ft of factory for manufacture of farm and poultry equipment. Spencerville, Ind. (struc., mech.) $100,000. Client, Rhinehart Mfg. Co., Fort Wayne, Ind.

Hazelet & Erdal, Louisville, Ky.
Indiana Turnpike, 15 miles, LaPorte-Porter County. $8,000,000. Client, Indiana Dept. of Hwys.

IOWA

Frank L. Pulley, Des Moines, Iowa.
High school building, Oskaloosa, Iowa. $750,000 (total), $250,000 (mech., elec.) Client, George Russell, A.I.A.

KANSAS

E. E. Hysom and Assoc., Wichita, Kans.
Home economics bldg. for Kansas State College. Completely air conditioned, 360 tons, two-duct high velocity system. Primary voltage system of 4160, broken into three separate systems. $700,000 (est. for mech. and elec). Client, Kansas State College.

KENTUCKY

J. Stephen Watkins, Lexington, Ky.
Electrical transmission and distribution system improvements, 22 miles of line and two new substations. (elec.) $350,000. Client, Vanceburg Utilities Comm., Vanceburg, Ky.

Hazelet & Erdal, Louisville, Ky.
Kentucky Turnpike, 15 miles, Louisville-Shepherdsville. $8,500,000. Client, Kentucky Dept. of Hwys.

North-South Expressway, Louisville. $9,000,000. Client, Dept. of Hwys.

LOUISIANA

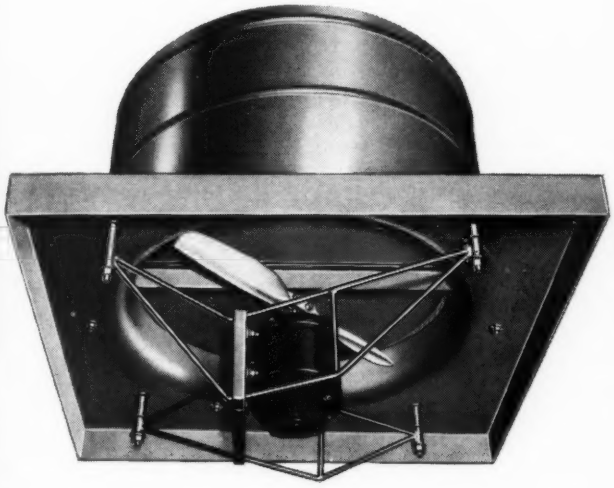
The Lummus Co., New York, N.Y.
Design and engineer ethylene oxide plant, Geismar, La. Client, Wyandotte Chemicals Corp.

Design and engineer ethylene oxide plant, Lake Charles, La. Client, Calcasieu Chemical Corp.

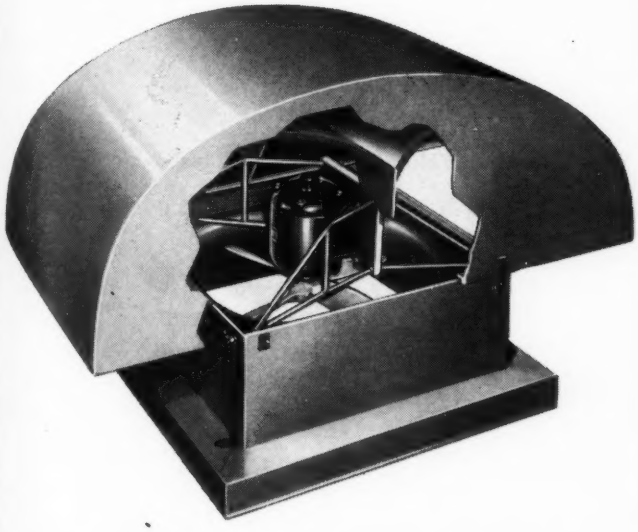
Irving B. Rau, New Orleans, La.
Bulkhead, seaplane ramp, and hangar, warehouse building, docks. Morgan City, La. (civil, struc., mech., elec.) $500,000. Client, Kerr-McGee Oil Industries, Inc., Morgan City, La.

Warehouse and office building for B.F. Goodrich Co., New Orleans, La. (struc.) $600,000. Client, Stoffle & Finger, Arch., New Orleans, La.

Pan American Engineers, Alexandria.
Surveys and mapping for rights of way



HARTZELL VERTIJET — Windband formed from 20 gauge galvanized steel, base from 14 gauge zinc-grip coated steel. Fan ring is integral part of base sheet. Two semicircular galvanized lids at base of windband open automatically when fan goes on, close weather-tight when it goes off. Throat sizes from 18" to 60"



HARTZELL REVERSIBLE ROOF VENTILATOR—One unit does the job of two conventional one-way ventilators. This unit moves air in either direction with equal efficiency; you convert from intake to exhaust at the flick of a switch. Throat sizes from 28" to 44".

Why You Can Count on Hartzell Air-Moving Equipment for Long Life, Rugged Reliability and Minimum Maintenance

Hartzell fans and blowers are engineered and built for the exacting requirements of tough industrial service. There's no compromise with quality for the sake of shaving a few dollars on price. Hartzell fans are designed for the industrial buyer who is willing to pay for long life, dependable service and low maintenance.

Design Simplicity OF HARTZELL *roof ventilators means...*

HIGH EFFICIENCY . . .

These Hartzell roof ventilators expel large volumes of heat, smoke and fumes quickly and efficiently because simplified design reduces obstructions to air flow. There's no maze of interior braces and supports. And all Hartzell roof ventilators are tested for performance in accordance with Standard Test Codes of the American Society of Heating and Air Conditioning Engineers.

LOW INITIAL COST . . .

Elimination of complications of design and construction produce savings in production costs which are passed along to you. Hartzell design simplicity means that Hartzell roof ventilators can offer top quality construction for long life and dependable service at a price much lower than that of more complex designs.

MINIMUM MAINTENANCE . . .

By minimizing the number of moving parts Hartzell reduces the number of things that can go wrong. Lids on vertical discharge models are mounted on corrosion resistant brass rods which turn on heavy Micarta plastic bearings which require no lubrication . . . won't stick, won't rust. Fan motors are ball-bearing type, conservatively rated for continuous performance. Under normal operating conditions, the only maintenance required will be periodic motor lubrication.

Write today, or ask your nearby Hartzell field engineer for a copy of the free Bulletin A-112A. It contains all the specifications for the two roof ventilators pictured, as well as for Hartzell's Airjet, Rotary and Penthouse roof ventilators.

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PROPELLER FAN CO.
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ENGINEERING OFFICES IN PRINCIPAL CITIES

on 10 miles of interstate highway system, Jennings to Egan, La. (civil) Client, Louisiana Dept. of Hwys.

Waterworks extensions. (civil) $800,000. Client, City of Pineville, La.

Sewer extensions. (civil) $410,000. Client, City of Pineville, La.

Fire protection. (civil) $90,000. Client, City of Pineville, La.

Bedell and Nelson Engineers, Inc., New Orleans, La.
Old River navigation lock. Joint venture with A. W. Thompson & Associates. (struc., mech., elec.) $14,000,000. Client, Corps of Engineers, New Orleans District.

J.S. Boyd and Assoc., Shreveport, La.
Municipal swimming pool, 40 x 82 ft and bathhouse. (civil) $28,000. Client, Mayor R. M. Enloe, Dubach, La.

Sewage collection system and treatment plant. (civil) $565,000. Client, Farmerville, La.

Municipal jail building. (civil) $9000. Client, Cullen, La.

Sewage collection system and treatment plant. (civil) $320,000. Client, Cullen.

Purchase private water system and rehabilitate to give fire protection and storage. (civil) $215,000. Client, Cullen.

MASSACHUSETTS

Stressenger, Adams, Maguire & Reidy, Boston, Mass.
Multistory headquarters office building for Massachusetts Blue Cross-Blue Shield, Boston, Mass. (mech., elec.) $4,500,000. Client, Anderson, Beckwith & Haible-Paul Rudolph, associated architects, Boston, Mass.

Wellesley College art center, Wellesley, Mass. (mech., elec.) $2,500,000. Anderson, Beckwith & Haible-Paul Rudolph, associated architects, Boston, Mass.

Harvard Cooperative Society, Cambridge, Mass. (mech., elec.) $350,000. Client, Perry, Shaw, Hepburn & Dean, Arch., Boston, Mass.

City Hall, Pittsfield, Mass. (struc., mech., elec.) $1,000,000. Client, Perry, Shaw, Hepburn & Dean, Architects, Boston, Mass.

Stewart Associates, Inc., Cambridge.
Pentucket Junior-Senior High School, W. Newbury, Mass., sewage disposal. $65,000. Client, Korslund, Le Normaud & Quann, Arch.

Wilmington Elementary School, Wilmington, Mass., storm drainage and sewage disposal. (mech.) $800,000. Client, Donaldson R. McMullin Assoc.

Francis J. Linehan, Jr., Boston, Mass.
New high school, Marshfield, Mass. (mech.) $1,250,000. Client, Haldeman and Jacoby, Arch., Brockton, Mass.

New elementary school, Burlington, Mass. (mech., elec.) $710,000. Client, Mario V. Caputo, Arch., Boston, Mass.

Henry Hagel, Baltimore, Md.
School alteration, Lexington, Mass. Client, **Maguolo & Quick, Architects & Engineers.**

MARYLAND

Henry Hagel, Baltimore, Md.
5-story Mother's House, Bethesda, Md. $2,500,000. Client, Sister of Mercy of the Union. **Maguolo & Quick, Architects & Engineers, William H. Thompson, Mech. Engineer.**

Herbert Manuccia, P.E. and Assoc., Washington, D.C.
Nursery school, Montgomery County, Md. (civil, struc.) $100,000. Client, Joseph Miller, Arch.

MICHIGAN

Stuart D. Long, Grand Rapids, Mich.
Men's dormitory building for Central Michigan College, Mt. Pleasant, Mich. Four-story, with individual 2-room student suites, ventilated lounge and recreation room with colonnade entrance to Food Commons Building. (mech., elec.) $1,000,000. Client, Roger Allen & Assoc., Arch.

Married student apartments, 6 units for Ferris Institute, Big Rapids, Mich., consisting of 16 one- and two-bedroom apartments with individual temperature controls and wired television. (mech., elec.) $900,000. Client, Roger Allen & Assoc., Arch.

LaPorte & Penn, Consultants, Detroit.
Prepare plans for two bridges carrying US-25 over Detroit-Toledo Expressway, 1.3 miles west of Trenton, Mich. (civil, struc.) $475,000. Client, Michigan State Hwy. Dept.

Prepare plans for bridge carrying US-16 (reloc.) over existing US-16, near limits of Portland, Mich. (civil, struc.) $240,000. Client, State Hwy. Dept.

Hazelet & Erdal, Louisville, Ky.
Edsel Ford Expressway structures. $15,000,000. Client, State Hwy. Dept.

Grand Rapids Expressway. $8,000,000. Client, Michigan State Hwy. Dept.

Houghton-Hancock bridge. $9,000,000. Client, Michigan State Hwy. Dept.

Harold N. Davidson, Kalamazoo, Mich.
Addition to Edison School, Kalamazoo, Mich. (struc.) $800,000. Client, Stapert, Pratt, Bulthuis, Sprau & Crathers, Inc.

Harry J. Fuller, Mt. Clemens, Mich.
Residential street paving. (civil) $800,000. Client, City of East Detroit, Mich.

Residential street paving. (civil) $200,000. Client, Village of Roseville, Mich.

Suhr, Peterson, Peterson & Suhr, Inc., Chicago, Ill.
Sewage treatment plant. (civil, struc., mech., elec.) $350,000. Client, City of Ironwood, Mich.

Intercepting sewer. (civil) $150,000. Client, City of Ironwood, Mich.

E. Roger Hewitt Assoc., Inc., Lansing.
Blood derivatives building, Michigan Department of Health, Lansing, Mich. (mech., elec.) $550,000. Client, Lee Black and Kenneth C. Black.

South side high school, Lansing, Mich. (mech., elec.) $4,500,000. Client, O. J. Munson Assoc.

County court house and jail, Muskegon, Mich. (mech., elec.) $3,500,000. Client, Magnuson & Sumner, O. J. Munson Assoc.

Edward W. Sparrow Hospital addition, Lansing, Mich. (mech., elec.) $2,000,000. Client, O. J. Munson Assoc.

McLaughlin Hospital, Lansing, Mich. (mech., elec.) $1,300,000. Client, Clark Ackley.

Remodel dairy building, M.S.U., East Lansing, Mich. (mech., elec.) $175,000. Client, O. J. Munson Assoc.

MINNESOTA

L. E. Lane, Willmar, Minn.
Additional water well. (civil) $10,000. Client, Village of Pennock, Minn.

Gausman and Moore, Inc., St. Paul.
Abbey at St. John's University, Collegeville, Minn. Capacity — 2000, reinforced concrete structure with granite veneer exterior. Heating and ventilating consisting of radiant floors augmented with heat supplied by ventilating system. (mech., elec.) $1,500,000. Client, St. John's University.

Nielsen and Bruch, Minneapolis, Minn.
Air conditioning, heating, and ventilating of Curtis Motor Lodge with accommodations for 38 units and provisions for addition of 19 units, including gate keeper's lodge. (mech.) $400,000. Client, Curtis Hotel, Minneapolis, Minn.

Remodel heating, ventilating, air conditioning, and plumbing of office building for First Federal Savings and Loan Assoc. (mech.) $750,000. Client, First Federal Savings and Loan Assoc., Minneapolis, Minn.

Lindsey, Carter & Assoc., Inc., Excelsior, Minn.
Water works system, preliminary report, new well, tank and tower, and distribution system. (civil) $80,000. Client, Village of Dayton, Minn.

MISSISSIPPI

John T. Pullen, Consulting Engineer, Memphis, Tenn.
Southside Elementary School, Columbus, Miss. $150,000. Client, W. I. Rosamond, Arch., Columbus, Miss.

Fairview Heights Elementary School, Columbus, Miss. $160,000. Client, W. I. Rosamond, Arch., Columbus, Miss.

MISSOURI

Leon Maslan & Co., Kansas City, Mo.
Manufacturing plant and office. Communications Accessories Co., Lee Summit, Mo. One-story, 52,000 sq ft with mezzanines. (struc.) $700,000. Client, Harold Berry, Arch., Dallas, Texas.

John T. Pullen, Consulting Engineer, Memphis, Tenn.
Gymnasium and field house, Hayti, Mo. $175,000. Client, Pleas E. Hyatt, Arch., Kennett, Mo.

Northeast Elementary School, Kennett, Mo. $170,000. Client, Pleas E. Hyatt, Arch., Kennett, Mo.

Russell & Axon, St. Louis, Mo.
Sanitary sewer and water system extensions. $207,000. Client, City of Campbell, Mo.

Sewage treatment plant and sanitary sewer extensions. Client, City of Cabool.

MONTANA

Miner and Miner, Consulting Engineers, Inc., Greeley, Colo.
180 miles of telephone lines near Ashland, Mont. (elec.) $70,000. Client, Range Telephone Coop, Inc., Forsyth.

NEBRASKA

Henningson, Durham & Richardson, Omaha, Nebr.
Sewage treatment plant, Hastings, Nebr. (civil, struc., mech., elec.) $450,000. Client, Hastings, Nebr.

Sewage treatment plant, Omaha, Nebr. (civil, struc., mech., elec.) $1,600,000. Client, Omaha, Nebr.

Sewage treatment plant, Beatrice, Nebr. (civil, struc., mech., elec.) $600,000. Client, Beatrice, Nebr.

Ballinger-Meserole Co., Philadelphia.
Grocery warehouse rehabilitation. Client, Nash-Finch Co., Grand Island.

NEW JERSEY

Goodkind & O'Dea, Bloomfield, N.J.
Bridge over Pompton River between Wayne Township and Lincoln Park. $400,000. Client, county engineers, Passaic & Morris Counties, N.J.

Rolf Eliassen Assoc., Winchester, Mass.
Biological waste treatment plant, Hi-Lo aeration process. (civil) $80,000. Client, Hohokus Bleachery, Hohokus.

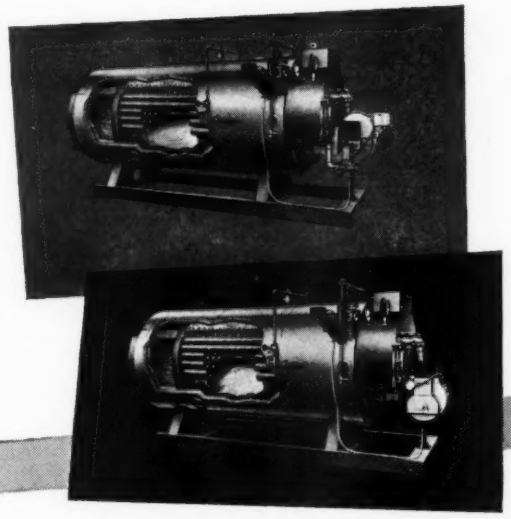
NEW MEXICO

Black-Veatch, Consulting Engineers, Los Alamos, N.M.
115-kv tie line to Santa Fe from Los Alamos, N.M., approx. 30 miles, including transformer station and associated equipment. (elec.) $1,000,000. Client, Atomic Energy Commission.

Additional power facilities. (elec.) $100,000. Client, Atomic Energy Comm.

Dr. Marcello Giomi & Assoc., Albuquerque, N.M.
Raton High School, Raton, N.M. $600,000. Client, Schaefer, Merrell, Pendleton & Assoc.

GOOD THINGS
(LIKE HIGH PRESSURE STEAM)
CAN COME IN
COMPACT PACKAGES



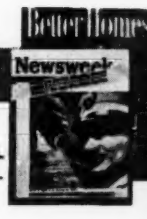
KEWANEE

ALL-WELDED
SCOTTIE JUNIOR

Are your next specifications for a laundry? A dairy? A cannery, tire recapper, frozen food packer, dry cleaner or other small industrial plant? When processing or power steam requirements figure at 75 hp or less, here is a complete, compact package for the job.

Scottie Junior is a Kewanee boiler and Kewanee burner matched to utilize every available Btu from oil or gas. Six sizes are produced, in both 125 and 150 lb wp. Even the largest Scottie Junior fits under an 8 ft. ceiling, arriving on the job with burner, wiring and all controls in place.

Other Kewanee boilers range to 651 hp and are always ready to prove their world-wide reputation for your clients. Your nearby Kewanee Man has full details, including catalog and specification sheets. Call him anytime. AMERICAN-STANDARD, KEWANEE BOILER DIVISION, 101 Franklin Street, Kewanee, Illinois.



Kewanee Boilers are advertised regularly in national publications.

AMERICAN-Standard

KEWANEE BOILER DIVISION

High school gymnasium, Clovis, N.M. $250,000. Client, J. Burran, Arch.

Doctors' offices, Artesia, N.M. $110,000. Client, E. French, Arch.

J. L. Breese & Assoc., Santa Fe, N.M. Aztec Elementary School, Aztec, N.M., heating and plumbing. (mech.) $210,000. Client, **Garland & Phillippi, Architect & Engineers,** Farmington, N.M.

Dining hall, capacity — 400, Phase 11, Presbyterian summer camp, Abiquiu, N.M. (mech.) $65,000. Client, W. T. Harris. Arch., Hobbs, N.M.

Rocky Mountain Engineering Co., Denver, Colo.
Storage building for inflammable materials, White Sands Proving Grounds, White Sands, N.M. (civil, struc., mech., elec., arch.) $175,000. Client, U.S. Corps of Engineers, Albuquerque, N.M.

Netaani-Nez Motel and coffee shop, Shiprock, N.M. (civil, struc., mech., elec., arch.) $136,000. Client, Navajo Tribe, Window Rock, Ariz.

NEW YORK

DeLeuw, Cather & Brill, New York. Section of Northway in New York State above Albany. Surveys, contract plans, and estimates for 7½ miles limited access highway with 5 grade separation structures. (civil, struc.) $5,000,000. Client, New York State Dept. of Public Works.

Jacob Feld, New York, N.Y.
19-story apartments, New York City. $6,000,000. Client, Leon & Lionel Levy.

Club house for Yonkers Raceway, Yonkers, N.Y. $5,000,000. Client, Lionel Levy, Arch.

Greenhut & Taffel, New York, N.Y.
U.S. post office, New York City, structural steel. (struc.) $750,000. Client, Wechsler & Schimenti, Arch.

19-story reinforced concrete apartment house, New York City. (struc.) $3,000,000. Client, Sylvan Bien, Arch.

16-story reinforced concrete apartment house, New York City. (struc.) $2,000,000. Client, Hippolyte Kamenka, Arch.

Henry J. Campbell, Jr., Mineola, N.Y. Design heating, ventilating, air conditioning, and electrical system for Syosset office, Hempstead Bank, Syosset, N.Y. (mech., elec.) $150,000. Client, Architect, Frank Majer, Jr.

Newsday, Inc., Garden City, N.Y. New mail room, additions to stereo room, partial modernization of press room. Heating, air conditioning, industrial ventilation, plumbing, and electrical. (mech., elec.) Client, Architect, Albert A. Wood.

Air condition three branch offices of bank. (mech., elec.) $70,000. Client, Franklin National Bank, Franklin Square, N.Y.

Goodkind & O'Dea, Bloomfield, N.J.
Interstate Route 1 from Malta to Saratoga Springs, N.Y. 8.7 miles of 6-lane divided highway, including 3 interchanges and 9 bridges. $8,000,000. Client, New York State Dept. of Public Works.

Grade crossing elimination, Hicksville, L.I. Elevating 3 miles of main line and Port Jefferson branch of Long Island R.R., including structures over eight crossroads, 3000 ft of viaduct structure, new station facilities, and freight yard. $10,000,000. Client, New York State Dept. of Public Works.

NORTH CAROLINA

John R. Gove, Engineer, Chapel Hill.
Sewage treatment plant (biofiltration), including trickling filter, primary clarifier, secondary clarifier, 0.5 mgd capacity. $80,000. Client, Town of Carrboro, N.C.

Louis P. Booz, Perth Amboy, N.J.
Additions and alterations to Durham, N.C., incinerator. $400,000. Client, Durham, N.C.

NORTH DAKOTA

L. W. Burdick, Engineers, Grand Forks.
New addition to Bismarck water treatment plant, consisting of new chemical feeders, water softening basin, and new filters and recarbonation units. $850,000. Client, City of Bismarck, N.D.

New water treatment plant at Neche, N.D. Capacity 0.5 mgd, including water distribution system and 50,000 gal elevated storage reservoir. $350,000. Client, City of Neche, N.D.

Construction of new sewage stabilization pond and complete sewerage system for city, including sewage lift station. $200,000. Client, City of Pembina.

Construction of 500 gpm sewage lift station and force main with sewer extensions for over half of city. Water extensions included in project. $200,000. Client, City of Lakota, N.D.

Construction of sewage stabilization pond, sewage lift station, and complete sewerage system. $250,000. Client, City of Hannaford, N.D.

Construction of new treatment plant for city consisting of sewage stabilization lagoon with 2 lift stations and approx. 5 miles of 36-in. force main. $2,750,000. Client, City of Grand Forks.

OHIO

Hazelet & Erdal, Louisville, Ky.
Ohio Turnpike, 18 miles, Cleveland. $21,000,000. Client, Ohio Dept. of Hwys.

North-East Expressway, Cincinnati. $20,000,000. Client, Cincinnati, Ohio.

City of Cincinnati expressway system. $15,000,000. Client, Cincinnati, Ohio.

H. M. Morse & Co., Cleveland, Ohio.
Remodel building for use as parking garage. $300,000. Client, Hall Bros. Co.

William S. Hurley, Jr., Cleveland, Ohio.

Northeastern Ohio General Hospital. 25-bed with expansion to 100-bed. Hot water heating, chilled water air conditioning, individual fan coil units. One floor, partial basement. (mech., elec.) $500,000. Client, Arnold A. Peterson, Arch., Cleveland, Ohio.

George W. Raike, Ashland, Ohio.
Additional filter units and high service pumping facilities for Ashland, Ohio, water treatment plant. (civil, struc., mech., elec.) $120,000. Client, City of Ashland, Ohio.

Additions to existing substation, new electric substation, transmission line, and feeder additions for Wadsworth, Ohio. (civil, struc., elec.) $135,000. Client, City of Wadsworth, Ohio.

David R. Simpson, P.E., Akron, Ohio.
Addition to Washington High School, Massillon, Ohio. (struc.) $1,750,000. Client, Firestone & Motter, Arch., Canton, Ohio.

Greer Engineering Assoc., Inc., Montclair, N.J.
Prepare soils profile, make test borings, perform soils tests, and prepare soils engineering reports on 16 miles of roadway, Franklin and Delaware Counties, Ohio, Interstate 3, Design Section D-12. (civil) Client, Alden E. Stilson Assoc., Columbus, Ohio.

OKLAHOMA

Leon B. Senter, Tulsa, Okla.
Orville Wright Junior High School. (mech., elec.) $1,500,000. Client, School Dist. #1, Tulsa County, Okla.

W. F. Shaw & Assoc., Tulsa, Okla.
20-door island terminal garage and offices. Masonry and steel construction, Tulsa, Okla. $150,000. Client, Be-Mac Transport Co., Inc.

Lee M. Bush & Co., Oklahoma City.
Outfall sewers and sewage disposal plant. (civil) $500,000. Client, City of Cushing, Okla.

Water supply and distribution. (civil) $200,000. Client, City of Frederick.

OREGON

Stressenger, Adams, Maguire & Reidy, Boston, Mass.
Sheraton Hotel, Portland, Ore. (struc., mech., elec.) $2,750,000. Client, Perry, Shaw, Hepburn & Dean, Arch., Boston.

Jacobsen Engineering, Elkhart Lake, Wis.
Strap-pak packaging machine. (mech.) $100,000. Client, American Paper Strap Co., Portland, Ore.

Cornell, Howland, Hayes & Merryfield, Corvallis, Ore.
Design 1 mgd rapid sand filter water treatment plant, Winston, Ore. $140,000. Client, Winston-Dillard Water District.

Design 16-in. water transmission line, Forest Grove, Ore. $22,600. Client, City of Forest Grove, Ore.

Design sanitary sewer system and sewage treatment facilities, Fir Cove Addition, Lane County, Ore. $23,500. Client, Baird & Kindred.

Stevens & Thompson, Portland, Ore.
Industrial site plan, warehouse, cafeteria, outside utilities. (civil, struc.) $375,000. Client, Tektronix, Inc., and Tektronix Retirement Trust, Beaverdon, Ore.

Earth dam. (civil) $4,500,000. Client, City of Portland, Ore.

Water study. (civil) Client, City of Seaside, Ore.

Water treatment plant, 10.0 mgd. (civil) $1,350,000. Client, Oregon City and West Linn, Ore.

Stan H. Lowy & Assoc., Portland, Ore.
Hood River Hospital addition, Hood River, Ore. (struc.) $435,000. Client, Walter E. Kelly, Arch.

Evangelical Baptist Church, Portland, Ore. (struc.) $165,000. Client, Walter E. Kelly, Arch.

Cornell, Howland, Hayes & Merryfield, Corvallis, Ore.
Design primary sewage treatment plant for design population of 5200, Hood River, Ore. $37,000. Client, City.

Design interceptor sewer facilities, Hood River, Ore. $37,000. Client, City of Hood River, Ore.

Design mechanical and electrical systems for St. Helens High School, St. Helens, Ore. $670,000. Client, Annand, Boone & Lei.
Design mechanical and electrical systems for additions and alterations to Albany General Hospital, Albany, Ore. $420,000. Client, James L. Payne.

Design mechanical and electrical systems for Salem Methodist Home, Salem, Ore. $170,000. Client, James L. Payne.

PENNSYLVANIA

Wm. H. Glasgow, P.E., York, Pa.
McKinley Elementary School addition, York, Pa. 16-classroom addition, oil-fired steam heating with windowline radiation and radiant heat in two kindergarten rooms. (mech.) $500,000. Client, Hamme & Lenker, Arch.

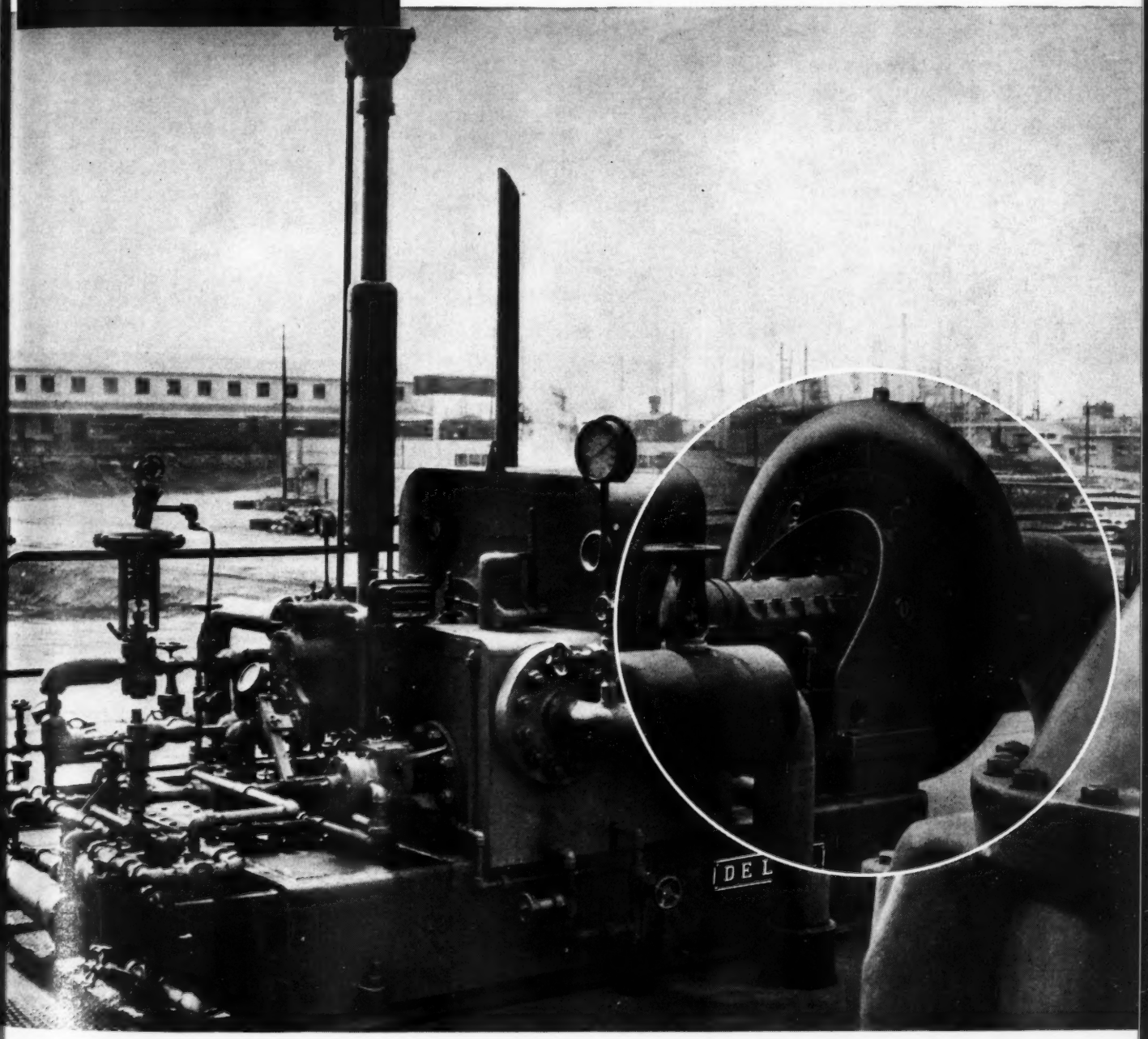
Two new girls' dormitories, Gettysburg College, Gettysburg, Pa. 4-story brick dormitories, gas-fired hot water heating, sill-lined radiation. (mech.) $600,000 ($300,000 each). Client, J. Alfred Hamme & Assoc.

H. G. Metzger, Jr. & Assoc., Huntingdon Valley, Pa.
All facilities and structures for 400-family private swimming club including pools, filter plant, small bar, dressing rooms, lockers, office, playgrounds, parking facilities, and site improvements. (civil, struc., mech., elec.) $200,000. Client, Capri Swim Club, Inc., New Britain, Pa.

Bailinger-Meserole Co., Philadelphia, Pa.

DE LAVAL
CENTRIFUGAL BLOWER

controls air in cat cracker at Standard Oil of California



This De Laval centrifugal blower, selected by the Fluor Corporation, is on stream at the Standard Oil Company of California's new cat cracker in El Segundo. For control air service, this blower delivers 9,500 cfm; inlet pressure is 15.4 psig and discharge pressure 19.4 psig. The blower is driven by a De Laval 220 brake horsepower MCP Turbine operating at 800 psig with a temperature of 650 F; it has all labyrinth shaft packing for high back pressure service.

In addition to single stage designs, De Laval makes a complete line of equipment for all refinery services, including multi-stage compressors driven by De Laval multi-stage turbines for condensing, non-condensing and automatic extraction applications.

Send for new Bulletin 0504

DE LAVAL *Centrifugal Blowers*

DE LAVAL STEAM TURBINE COMPANY

894 Nottingham Way, Trenton 2, New Jersey

Grocery warehouse. $1,000,000. Client, Food Distribution Center, Philadelphia.

Grocery warehouse. $75,000. Client, Fox Grocery Co., Charleroi, Pa.

Warehouse rehabilitation. Client, Mack Printing Co., Easton, Pa.

Warehouse. $70,000. Client, Penn-Jersey Auto Stores, Philadelphia, Pa.

The Lummus Co., New York, N.Y.
Extension to phthalic anhydride facilities, Neville Island in the Ohio River below Pittsburgh. $3,000,000. Client, Pittsburgh Coke & Chemical, Industrial Chemicals Div.

Gustav Stueber, Pittsburgh, Pa.
250-family apartment building. (Civil, struc.) $4,500,000. Client, Frank-John-Dougherty, Attorneys.

Mesta Machine Co., new storage and cafeteria building. (Struc.) $275,000. Client, Crump, Inc., Pittsburgh, Pa.

McClellan Elementary School, West Jefferson Hills, Pa. (Struc.) $1,200,000. Client, Joseph Hoover, Arch., Pittsburgh, Pa.

St. Mary's Catholic Church, Monessen, Pa. (Struc.) $150,000. Client, Harold Clark, Arch., Monessen, Pa.

Vininco Macaroni Products, Carnegie, Pa. Underpinning of process building. (Civil, struc.) $50,000. Client, Sam Viviana, Prop., Carnegie, Pa.

United Engineers & Constructors, Inc., Philadelphia, Pa.
Expansion program for steel plate plant, including 100-ton electric furnace, new ingot and slab soaking pits, and four-high 140-in. breakdown mill. $33,000,000. Client, Lukens Steel Co., Coatesville, Pa.

SOUTH CAROLINA

J. C. Harrison, Spartanburg, S.C.
Hospital unit addition, Greenwood, S.C. (mech.) $2,000,000. Client, Self Memorial Hospital.

Spartanburg Senior High School. (mech.) $3,500,000. Client, School Board.

Porter, Barry & Assoc., Baton Rouge, Louisiana.
Natural gas distribution system, Simpsonville, S.C. $150,091.58.

Natural gas distribution system, York County Natural Gas Authority. Rock Hill, S.C. $1,354,803.40.

Natural gas distribution system, Chester County Natural Gas Authority, Chester, S.C. $402,655.52.

Natural gas distribution system, Lancaster County Natural Gas Authority, Lancaster, S.C. $584,066.

Lockwood Greene Engineers, Inc., Spartanburg, S.C.
Reinforced concrete manufacturing plant with long span joists supporting precast concrete roof slabs. Load bearing walls are 12-in. Jumbo brick. Office and plant air conditioned. Client, Bigelow-Sanford Carpet Co., Inc., Calhoun Falls, S.C.

SOUTH DAKOTA

Henningson, Durham & Richardson, Omaha, Nebr.
Water works improvements, Yankton, S.D. (civil, mech., elec.) $425,000. Client, Yankton, S.D.

TEXAS

Kenneth E. Esmond & Assoc., Odessa.
20-year master plan for City of Odessa, Texas. (civil) $24,000,000. Client, City of Odessa, Texas.

Walker & Assoc., Inc., Houston, Texas.
Replacement of 620-ton refrigeration compressors of reciprocating type with new centrifugal refrigeration machinery in Esperson Buildings, Houston, Texas. (struc., mech., elec.) $135,000. Client, The Esperson Buildings, Houston, Tex.

Ballinger-Meserole Co., Philadelphia.
Grocery warehouse. $200,000. Client, Furr's, Inc., Lubbock, Texas.

Grocery warehouse. $50,000. Client, Piggly-Wiggly San Antonio Co., San Antonio, Texas.

Grocery warehouse. $160,000. Client, The Stedman Co., Beaumont, Texas.

Grocery warehouse. $100,000. Client, J. Weingarten & Co., Houston, Texas.

UTAH

Henry Schipke & Assoc., Minneapolis, Minn.
Automatic batching and mixing plant, including three automatic scales with feeders for dry ingredients and spraying system for liquids, three pneumatic systems for handling dry materials, and automatic batching of flour and sugar. Client, Pelton Spudnuts, Salt Lake City.

VIRGINIA

Griffith & Wright, Fairfax, Va.
Sewerage system, 50,000 linear ft. (civil) $220,000. Client, Dumfries Sanitary District, Prince William County Board of Supervisors, Va.

Sewage treatment plant. (civil) $100,000. Client, Dumfries Sanitary District Prince William County Board of Supervisors, Va.

Herbert Manuccia, P. E. and Assoc., Washington, D.C.
Agudas Achim Synagogue, Alexandria, Va. (civil, struc.) $400,000. Client, Joseph Miller, Arch.

Torrence & Dreelin, Consulting Engineers, Richmond, Va.
Feedmill, Harrisonburg, Va., for Rockingham Farmers Cooperative. 72 x 72 x 110 ft tall slip form reinforced concrete. (struc.) $200,000. Client, **D'Arcy P. Davis, Jr., Architect-Engineer**, Harrison, Va.

Library for Virginia State College, Petersburg, Va. 4-story, 100 x 160 ft, lift slab concrete. (struc.) $1,000,000.

RECO craftsman attaches copper lining to steel shell of one of the two storage heaters scheduled for duty at Columbia Hospital.

COLUMBIA HOSPITAL—MILWAUKEE, WISC.
Consulting Engineer
Albert H. Myers, Milwaukee
Contractors
A. L. Sauer, Inc., Milwaukee

Operation Hot Water by RECO a success at Columbia Hospital

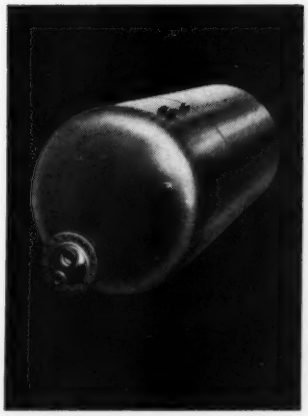
A hospital never lets up on its hot water demands. And RECO never lets Milwaukee's Columbia Hospital down when a hot water call comes through.

Day and night, two copper-lined RECO Hot Water Storage Heaters pour out over 2,000 gallons of rust-free hot water per hour for a hundred different hospital chores.

This kind of top performance is standard for RECO heat exchange equipment. That's why the nation's leading consulting engineers specify RECO for important hot water jobs.

Put the RECO guarantee of *top quality and top performance at the right price* into *your* next specifications. SPECIFY RECO!

For free catalogs plus name of nearest RECO representative, write Dept. Q, RECO, 7th & Hospital Sts., Richmond 5, Va.



RICHMOND ENGINEERING CO., INC.

Client, Walford & Wright, Arch., Richmond, Va.

Hayes, Seay, Mattern & Mattern, Roanoke, Va.
Oak Grove Elementary School. (Civil, struc., mech., elec.) $400,000. Client, Roanoke County.

Munson Hill High School. (Civil, struc., mech., elec.) $2,000,000. Client, Fairfax County.

Church, Roanoke, Va. (Civil, struc., mech., elec.) $250,000. Client, North Minister Presbyterian.

Interstate highway bridge. (Struc.) $2,500,000. Client, Commonwealth of Virginia.

Secondary highway bridge. (Struc.) $400,000. Client, Commonwealth of Va.

Railway bridge. (Struc.) $850,000. Client, N&W Railway Co.

Primary highway. (Civil) $2,000,000. Client, Commonwealth of Virginia.

Interstate highway. (Civil) $15,000,000. Client, Commonwealth of Virginia.

Urban highway. (Civil) $2,000,000. Client, Commonwealth of Virginia.

Primary highway bridge. (Struc.) $1,000,000. Client, City of Richmond, Va.

Water system. (Civil) $150,000. Client, Manassas, Va.

WASHINGTON

Cornell, Howland, Hayes & Merryfield, Corvallis, Ore.
Three Ranney type horizontal collectors on bank of Columbia River, with pipe pumping facilities and controls, Kennewick, Wash. $360,000. Client, City of Kennewick, Wash.

Design sanitary sewers for portion of City of Camas, Wash. $100,000. Client, City of Camas, Wash.

Design additions to existing water treatment plant of approx. 9 mgd capacity with 16 and 20-in. cast iron distribution pipelines, Pasco, Wash. $500,000. Client, City of Pasco, Wash.

Stevens & Thompson, Portland, Ore.
Sewers and sewage treatment. (civil) $2,000,000. Client, City of Aberdeen.

R. E. Layton & Assoc., San Leandro, Calif.
Construction plans and specifications for 2,000,000 gal elevated prestressed concrete water supply reservoir. Bottom of water carrying portion of reservoir approx. 60 ft from ground and supported on series of concentric reinforced concrete rings. Total height of reservoir approx. 110 ft from ground surface to top of dome, 100 ft in diameter. (civil, struc.) $250,000. Client, City of Seattle, Wash.

WEST VIRGINIA

Charles Henry Sack Assoc., Charleston, W. Va.
Alderson-Broaddus College, Philippi, W. Va. Women's dormitory, library, auditorium. Plumbing, heating, air conditioning, electric, area sewage disposal facilities. (Civil, mech., elec.) $263,000. Client, Martens & Son, Arch., Charleston, W. Va.

Weston High School, Weston, W. Va. Gymnasium, school building, utilities plant. Plumbing, heating, electric, services. (Mech., elec.) $200,000. Client, William H. Grant, Jr., Arch., Clarksburg, W. Va.

U.S. Bureau of Mines office building, Mt. Hope, W. Va. Plumbing, air conditioning, electric. $200,000. Client, Glenn C. Hancock, Arch., Charleston, W. Va.

James Sell, Charleston, W. Va.
W. Virginia turnpike. (Civil) $130,000,000 (est.) Client, engineer on right-of-way property sales.

School sites. (Civil) $200,000. Client, engineer for Kan. County Board of Education.

Mile branch sub-station and miscellaneous smaller subdivisions. (Civil) $200,000 (est.) Client, Phil Hill and other clients.

Gas wells, Wyoming Co. (Civil) Client, engineer for Wyoming Pocahontas.

WISCONSIN

Robert Irving Anderson, Milwaukee.
Halan's Supermarket, Milwaukee, Wis. air conditioned, "air-curtain" for entrance, hot water penthouse for air-cooled compressor. (mech.) $48,000. Client, Nefe-Diek.

Hazelet & Erdal, Louisville, Ky.
Wisconsin Interstate Highway. $26,000,000. Client, Wisconsin Hwy. Dept.

Ballinger-Meserole Co., Philadelphia.
Grocery warehouse. $100,000. Client, Schultz Brothers Co., Sheboygan, Wis.

Hitchcock & Estabrook, Inc., Minneapolis, Minn.
Supervise construction of sewage treatment plant to be built on filled ground in bay adjoining Superior. All structures to be carried on piling. $1,500,000. Client, City of Superior, Wis.

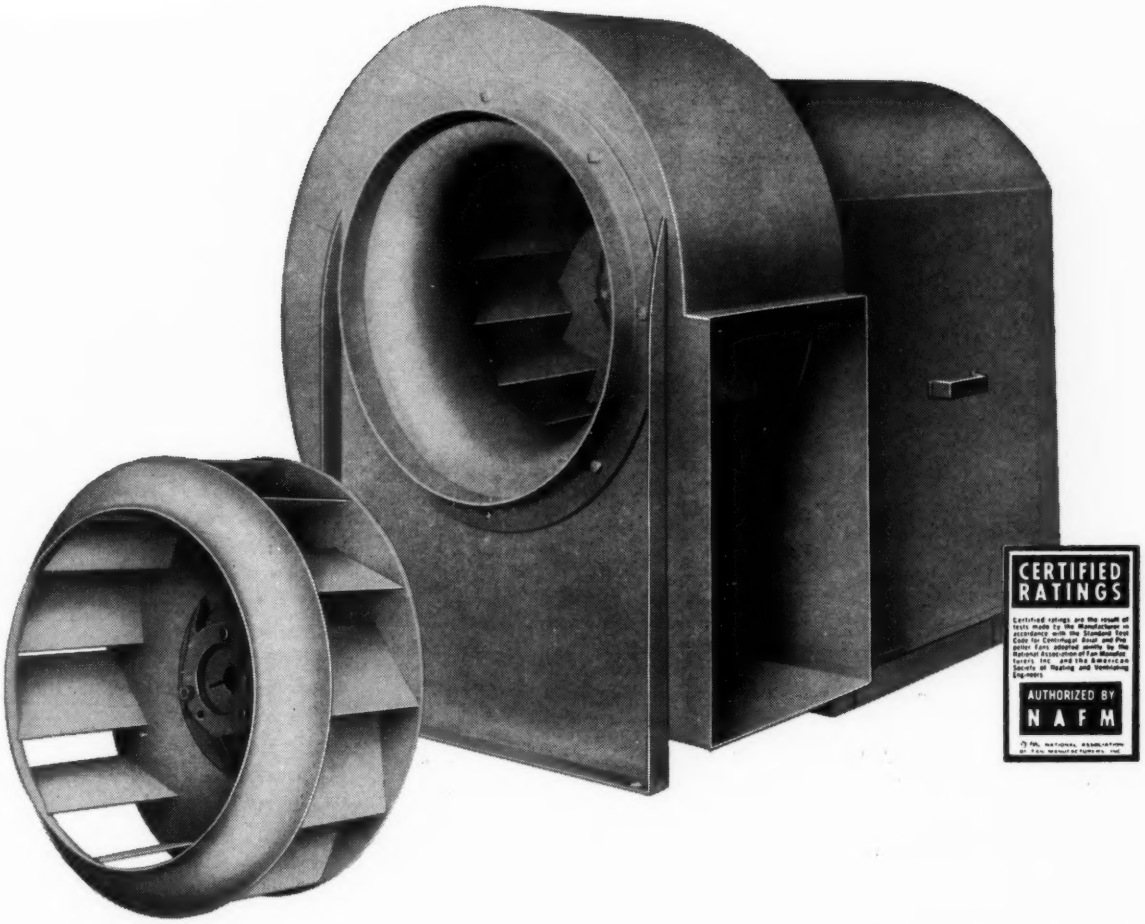
WYOMING

Ken R. White, Denver, Colo.
New office building for State of Wyoming (Cheyenne) (civil, struc.) $1,600,000. Client, Sam Hutchings, Arch.

FOREIGN

The Lummus Co., New York, N.Y.
Design and engineer ethylene oxide plant, Partington, England. Client, Petroleum Chemicals, Ltd.

Jack E. Mitchell & Assoc., Coral Gables, Fla.
General purpose auditorium, Fort Brook, Puerto Rico. (mech., elect.) $100,000. Client, Edwin T. Reed & Assoc.



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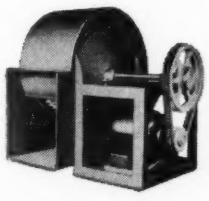
Completely Designed, Engineered and Manufactured by Peerless Electric

Peerless Backward Curve Blowers are all Peerless—motor and all. We control the entire production of this versatile blower, from drawing board to finished product. We guarantee it unconditionally for quiet, trouble-free operation.

Peerless Backward Curve Blowers can be specified with confidence. They are thoroughly tested according to test codes. They meet NAFM and NEMA standards. Scores of them are operating in schools, churches, hospitals and government installations.

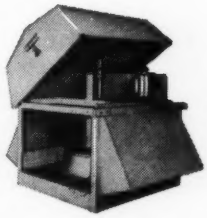


FORWARD CURVE BLOWERS

Made entirely by Peerless; arc-welded housings and frames; wheels designed for quieter operation; dynamically balanced.

CENTRIFUGAL ROOF VENTILATORS

Matching wheel cone accurately fits spun venturi for quieter, smoother air movement. All welded construction; material 16 ga. or over. Each unit air tested, and rated to assure certified PFMA ratings. Fits standard curbs.



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Books

For the Libraries of

Consulting Engineers

TIMBER DESIGN AND CONSTRUCTION HANDBOOK, prepared by The Timber Engineering Co.; F. W. Dodge Corp.; 622 pp.; $12.75.

Reviewed by
Andre H. Vanderzanden
Consulting Structural Engineer

An up-to-date and comprehensive textbook treating the design and construction aspects of timber is indeed a welcome addition to any structural engineer's library. The *Timber Design and Construction Handbook* adequately fills that need.

Three major factors have of recent years given rise to a substantial increase in the use of timber as a prime structural material: (1) availability, (2) cost, and (3) improvement of design and construction methods during the postwar years.

The Timber Engineering Company, an affiliate of the National Lumber Manufacturers Association, has brought together in this effort more than 25 of the leading authorities in the design, fabrication, assembly, erection, and maintenance of timber structures. The task of editing and coordinating all of this information was performed by Ralph H. Gloss, of Timber Engineering.

The book is organized generally in three broad sections, although some material is often repeated to advantage in another section. The first section concerns itself with the various properties and characteristics of wood, including the physical and nonstructural properties as well as the strength properties of the material. In addition there is a chapter on Commercial Lumber Standards.

The second section, the bulk of the text, deals with the design, fabrication, and erection of timber structures. The eight chapters in this section assemble for the engineer or student the design procedure for the many types of structural solutions available when using timber as a structural material. Post - and - beam construction, trusses, arches, Lamella roof construction, piles, wharf structures, framed towers, and other special framing are treated in detailed design methods. It should be noted here, however, that a working knowledge of structural theory and analysis is assumed by the authors.

Of particular importance in this section are the discussions, analysis, and detailing of the more recent developments in the field of timber engineering, such as glued laminated members and plywood built-up structural elements. Throughout this section attention is always focused by the authors not only on the design of components, but the importance of proper and adequate connections, with the thought always in mind of ease of assembly and economy. This thinking is further amplified by discussions based on actual experience concerning the fabrication, assembly, and erection procedures.

The third, and last section, can be regarded as a very useful handbook of reference data set up in tabular form along with necessary specifications as selected by the

National Lumber Manufacturers Association. The information in the section is coordinated and grouped in such a manner that the design engineer will, without undue loss of time, find the data necessary to answer his particular problem. A chapter on the preparation of specifications dealing with lumber and timber is included to make the text a really complete work on the subject.

Our expanding and dynamic economy is demanding more and more material to satisfy the needs of mankind. We must therefore, of necessity, make more efficient use of each pound of material available to us. This book must certainly be regarded as a worthy contribution to the search for the proper and economical use of one of our most basic materials, wood.

ALSO AVAILABLE

INVESTMENT CASTING ENGINEERING & DESIGN MANUAL; Investment Casting Institute; 50 pp.; $5.00.

This manual has been designed to aid industry to understand more clearly the advantages and limitations of the investment casting process, and should be of value to the design engineer and metallurgist.

Of particular importance is the manual's design section which presents rules governing design, dimensional tolerances, and shapes possible.

One section is devoted to the Institute's metal specifications and test bar standards. The manual contains more than 70 illustrations, including several dozen engineering drawings that supplement the design information text.

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THE HEATING, VENTILATING AND AIR CONDITIONING GUIDE, 1957, 35th ed.; The American Society of Heating and Air-Conditioning Engineers; $12.00.

A good part of the Guide has been revised or added to. New tables, illustrations, and design criteria have been included.

The 51 chapters have been grouped into seven sections: Fundamentals, Human Reactions, Heating and Cooling Loads, Combustion and Consumption of Fuels, Systems and Equipment, Special Systems, Instruments and Codes.

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The American Road Builders' Association has available a 12-page bulletin, "Highway Lighting," which contains some of the more important factors to be considered in design of a highway lighting system. The price is 50¢ from ARBA, World Center Building, Washington 6, D.C.

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Proceedings of the 1956 National Electronics Conference can be obtained from the conference headquarters, 84 E. Randolph St., Chicago, at $5.00 a copy. The 1095-page, cloth-bound book contains 105 technical papers and three luncheon addresses presented at the meeting last October.

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The Industrial Management Society has available a 20-page booklet describing 60 films on work simplification methods of leading American industrial concerns. Entitled "Work Simplification on Film," the booklet can be obtained from the Society, 330 South Wells St., Chicago 6, Ill.

FILMS

"BARREL TYPE BOILER FEED PUMP," Allis-Chalmers Mfg. Co., 16 mm, sound and color, 20 min.

This film covers the manufacture of the pump, including radiographic inspection with the betatron, parts machining, and tests.

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"SPEEDING THE DISTRIBUTION OF ENGINEERING DRAWINGS BY XEROGRAPHY," The Haloid Co., sound and color, 15 min., 16 mm.

This film depicts the use of XeroX Model 1218 copying equipment at IBM, Ford, Chrysler, and Glenn L. Martin in the xerographic reduction of outsize engineering drawings up to 24 by 36 inches, to convenient 12 by 18-inch proportions on offset paper masters from which multiple copies are then run off. ▲▲